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**FY 2001 PERFORMANCE PLAN**

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# **NASA FY 2001 Performance Plan**

## **Background and Introduction**

### **The Government Performance and Results Act**

The Government Performance and Results Act (GPRA) was passed by Congress and signed by the President in 1993. GPRA was enacted to improve the efficiency of all Federal agencies, with the following specific goals:

Improve Federal program management, effectiveness, and public accountability  
Improve congressional decisionmaking on where to commit the Nation's financial and human resources  
Improve citizen confidence in Government performance

The Act directs Executive Branch agencies to develop a customer-focused strategic plan that aligns activities with concrete missions and goals. The first strategic plans were to be submitted in September 1998 as part of the Fiscal Year 1999 (FY 1999) budget process. The budget submissions were to support the goals expressed in the agency strategic plans. The Act also directs agencies to manage and measure results to justify Congressional appropriations and authorizations. Six months after the completion of the fiscal year, agencies will report on the degree of success in achieving the goals and evaluation measures defined in the strategic and performance plans. The first such report will be furnished to the Congress in March 2000, covering the performance in FY 1999.

### **NASA's Strategic Management System**

Processes within NASA's Strategic Management System provide the information and results for GPRA's planning and reporting requirements. The System is defined in the NASA Strategic Management Handbook (NASA Procedures and Guidelines 1000.2). Figure 1 illustrates the hierarchy of documentation for the Strategic Management System.

The NASA Strategic Plan (NASA Policy Directive 1000.1) defines the vision, mission, and fundamental questions of science and research that provide the foundation of the Agency's goals. The Plan describes four Strategic Enterprises that manage the programs and activities to implement our mission, answer the fundamental questions, and provide service to identified customers. These Strategic Enterprises are *the Space Science Enterprise, the Earth Science Enterprise, the Human Exploration and Development of Space Enterprise, and the Aero-Space Technology Enterprise*. The support systems for the Strategic Enterprises, defined as Crosscutting Processes, are also defined in the Strategic Plan. These Crosscutting Processes are *Manage Strategically, Provide Aerospace Products and Capabilities, Generate Knowledge, and Communicate Knowledge*.

Interested readers may access these Strategic Management System documents through the Internet.

It should also be noted that the Final FY 2001 Performance Plan reflects the Strategic Plan in force at the time the President's Budget was released. NASA is currently working on the next Strategic Plan, due to be released in September 2000.

In the NASA Strategic Plan, the vision and mission statements of the Agency are articulated. We reprint them here for the convenience of the reader.

## **NASA Vision Statement**

***NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.***

## **NASA Mission Statement**

- ***To advance and communicate scientific knowledge and understanding of the Earth, the solar system, and the universe and use the environment of space for research;***
- ***To advance human exploration, use, and development of space;***
- ***To research, develop, verify, and transfer advanced aeronautics, space, and related technologies.***

## **Outcomes of NASA's Activities**

Government investment decisions on funding for space and aeronautics research and technology cannot be made knowing in advance the full benefits ("outcomes") that will accrue from making the investments. Nor, can the timetable be known as to when these benefits will be realized. However, we can identify how the outcomes of NASA's activities contribute significantly to the achievement of America's goals in four key areas:

Economic growth and security – NASA conducts aeronautics and space research and develops technology in partnership with industry, academia, and other federal agencies to keep America capable and competitive.

Educational Excellence – NASA involves the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds.

Peaceful Exploration and Discovery – NASA explores the Universe to enrich human life by stimulating intellectual curiosity, opening new worlds of opportunity, and uniting nations of the world in this quest.

Preserving the Environment – NASA studies the Earth as a planet and as a system to understand global climate change, enabling the world to address environmental issues.

Performance targets supporting the first three outcomes can be found in all of the Enterprises and Crosscutting Processes. Performance targets supporting the preservation of the environment can be found in the Earth Science Enterprise.

## NASA's Fiscal Year 2001 Budget

The NASA FY01 budget request (Figure 3) reaffirms the President's commitment to support NASA's space and aeronautics program. This budget will support the Agency's priorities as directed by the National Space Policy and the President's Goals for a National Partnership in Aeronautics Research and Technology. NASA's priorities include a commitment to safety for human aeronautics and space flight, the assembly of the International Space Station, and the development of the Next Generation Launch Vehicle. The budget also provides support for an aggressive space science program, a program of long-term observation, research and analysis of Earth from space and revolutionary advancements that will sustain global U.S. leadership in civil aeronautics and space.

The successful execution of NASA's strategic goals and objectives is contingent on receipt of the requested appropriations, as well as the provision of funds, materials, or services which have been committed to the cooperative agreements or partnerships that are referenced in this document. The parties to these agreements include: foreign governments, other Federal Agencies or Departments, and commercial entities.

### Fiscal Year 2001 Estimates (In millions of Real Year Dollars)

	<u>FY1999</u>	<u>FY2000</u>	<u>FY2001</u>	<u>FY2002</u>	<u>FY2003</u>	<u>FY2004</u>	<u>FY2005</u>
<u>NASA Total Budget \$M</u>	<u>13,653</u>	<u>13,601</u>	<u>14,035</u>	<u>14,465</u>	<u>14,769</u>	<u>15,305</u>	<u>15,570</u>
Space Science	2,119	2,193	2,399	2,606	2,961	3,299	3,578
Earth Science	1,414	1,443	1,406	1,333	1,293	1,303	1,306
Human Exploration & Development of Space*	6,309	6,238	6,332	6,189	5,629	5,442	5,313
Aero Space Transportation Technology	1,339	1,125	1,193	1,549	1,949	2,245	2,303
Mission Support/IG/Other	2,472	2,601	2,706	2,789	2,936	3,017	3,071
Civil Service FTEs	18,469	18,623	18,954	18,970	18,971	18,777	18,562

The Mission Support line includes the indirect cost of operating the NASA institution, including personnel providing direct and indirect support.

Under the FY2001 submission structure, the cost of Full Time Equivalents and related travel directly supporting the Projects and Programs of the various Enterprises are displayed in the Mission Support account. As NASA moves into the era of full cost management, the budget for the Mission Support and Other elements will be directly allocated to the programs and projects.

For informational purposes, the Enterprise sections of this plan will display the Civil Service staffing levels assigned to the Enterprise. There are also tables in each of the sections that provide the reader with a crosswalk between the performance targets,

the strategic objectives and the appropriate budget line item.

Additional detail on the means and strategies for accomplishing these performance targets is included in the budget narrative sections of this document. The NASA FY01 Budget is also available through the NASA homepage at the following internet address:  
<http://ifmp.nasa.gov/codeb/budget2001/>

## **NASA Performance Plan**

This document, as required by GPRA, describes performance measures and service levels for program activities requested in the FY01 budget. Performance goals and objectives are defined for NASA's Strategic Enterprises and for Crosscutting Processes in the NASA Strategic Plan, with 1999 Interim Adjustments (NPD 1000.1).

NASA has instituted several major changes with the FY01 Performance Plan. NASA has revised its approach to the development of performance targets. The targets contained in the FY01 Performance Plan have been developed to enable a better understanding of how the specific measures of output (indicators) contribute to the eventual outcomes that are the result of a number of years of research, development, and data analysis. The performance targets in the FY01 Performance Plan have been developed specifically to enable us to display indicators from multiple years which will contribute to the achievement of the summary targets. This change in format will ultimately allow a more concise representation of the agency's performance that will more readily span multiple years and enable decisionmaking of the type intended by the authors of GPRA. NASA believes that this process improvement will better serve the needs of the public, our governmental customers and agency management.

This plan thus represents a transition which must bridge the distance between the previous approach and the future more concise representation. Performance targets from previous performance plans more closely approximate the indicators in the FY01 Performance Plan. The Indicators supporting each of the performance targets are identified in an appendix to this plan.

Following the narrative sections, each Enterprise or Crosscutting Process will include the following displays:

- A table which relates the Strategic Goals, Strategic Objectives, and FY01 Performance Targets. The types of indicators being used to evaluate performance against those targets are characterized in the final column.
- A table which recaps the relationship of budget account, target, and performance indicators.

*To facilitate configuration management, control numbers have been assigned to all performance targets. The numbering sequences may not be contiguous, as targets may have been dropped out as the formulation process progressed.*

## **The Performance Evaluation Process**

NASA uses a process of extensive internal and external reviews to evaluate our progress against established plans.

Internally, there are standard monthly and quarterly project and program level reviews at the NASA field installations, at contractor installations, and at NASA Headquarters. There are regular reviews for functional management activities, such as procurement, finance, facilities, personnel, information resources management, etc. There are reviews of science, engineering, and technology plans and performance. The NASA Inspector General conducts independent reviews and provides recommendations for corrective actions.

NASA has established management councils, as described in the NASA Strategic Management Handbook, that conduct internal oversight reviews. Throughout the year, Program Management Councils (PMCs) at Headquarters and the Centers assess program schedules, cost, and technical performance against established programmatic commitments. The Senior Management Council (SMC) brings together both Headquarters and Field Installation Directors to conduct assessment review twice a year of the progress being made in meeting the Enterprise and Crosscutting Process performance targets.

NASA's extant management review processes provide appropriate forums for internal reporting and reviewing of project and program performance data. The recent streamlining of agency processes provides confidence that new data collection and oversight processes need not be created for compliance with GPRA. Our mission oriented organizational structure and established management processes are well suited to assessment of this type of performance evaluation.

There are also significant external review processes in place. The external reviews typically begin with the peer review processes in which NASA uses panels of outside scientific experts to ensure that science research proposals are selected strictly on the merits of the planned research. This process takes into account past performance for selection and/or continued funding.

External reviews of agency performance are conducted by a number of organizations. An independent accounting firm annually audits NASA's financial statements, including program and functional performance parameters, which leads to the publication of the *Accountability Report*. NASA requests assistance from other federal agencies to provide expert advice and council. In some cases, the organizations are advisory bodies of experts from the public and private sectors that work with NASA to establish priorities in particular scientific disciplines. In other cases, reviews are conducted by organizations such as the NASA Advisory Council, the Aerospace Safety Advisory Panel, the National Academy of Sciences, and the General Accounting Office, which share responsibility for oversight of the Agency. The Occupational Safety and Health Administration and the Environmental Protection Agency will also provide reviews of performance unique to their agencies during the fiscal year.

The use of these external reviews allows NASA to receive a report card on whether we are making the anticipated progress towards accomplishing the priorities established by the Administration, the Congress, and our advisory bodies. When necessary, these external assessments result in the revision of either implementation plans or strategic plans.



## **The GPRA Performance Evaluation and Report Process**

For the purposes of the GPRA performance reporting process, NASA intends to use NASA's advisory committees as the critical input. These committees already opine on NASA's Strategic Plan, individual Enterprise Strategic Plans, and budgetary priorities. NASA furnishes program performance status information, and in turn, the committees render advice and council. It is this process that NASA will employ to generate an independent "scorecard" report on our annual performance.

NASA has historically been one of the most open federal agencies in terms of performance measurements. Public attention is drawn quickly to program successes, and particularly to program failures. Press conferences on the scientific results and program technical status are commonplace. The technical measurement of program progress is a management imperative due to the heavy emphasis on development programs, and within the programs, the specific projects. Flight programs such as the International Space Station compile thousands of technical performance metrics, schedule milestones, and cost performance data.

However, the GPRA requires a heavier focus on outcome metrics rather than NASA's ubiquitous input and output metrics. Like other federal agencies engaged in science and technology, NASA has difficulty in quantifying outcomes and, especially, relating current outcomes to current fiscal expenditures. This is particularly the case since NASA development programs are multi-year in character. In some cases, the past expenditures began more than a decade ago, such as the Hubble Space Telescope that entered into development in the mid-1970's. More recently, NASA has focussed on programs and projects with much shorter development periods, on the order of 3-5 years. Yet, the science outcomes are dependent on scientists analyzing the information gathered in the years after launch.

The stated objectives of programs within NASA's Enterprises are long-term in character. This is exemplified by considering a Space Science performance objective, "Solve the mysteries of the universe." Annual performance evaluations assess whether appropriate progress is being made, perhaps actually solving individual "mysteries" to the satisfaction of the scientific community, or providing additional insights to the eventual solution of other mysteries. The assessment process requires a multifaceted judgement which takes into account the nature of the challenge of "solving the mystery," the level of resources available to be applied, and the actual scientific achievements of the past year.

It is particularly important in our view to avoid evaluating actual output performance in R&D organizations solely by counting the number of planned events for the year with the number that actually occurred. The "beancount" approach is more appropriate to a known manufacturing environment. In the high-performance, high-risk R&D environment that characterizes NASA's programs, it is inadvisable to incentivize on-time performance and thereby de-emphasize safety, quality, high performance and appropriate risk-taking.

NASA has worked hard to maintain the highest emphasis on maintaining safety; this value applies not only to safety of personnel but also to preservation of high value facilities, equipment, experimental hardware, and related capabilities. Quality goes hand-in-hand with safety, but extends well beyond it. For example, taking credit for completing a critical design review (CDR) for a spacecraft is only appropriate when the CDR process has been thorough, complete, and meets performance standards. Great care must be taken that quality does not suffer when contract fee incentives call for a milestone payment upon completion of the CDR. Other examples abound, and give rise to our constant vigilance to avoid rushing to launch in order to achieve a given date.

It is possible, of course, to emphasize safety and quality and achieve little of lasting significance or have the achievement take an inordinate amount of time. Building spacecraft that do not test new designs, but rely only on proven designs, is appropriate for operational, mission agencies or commercial entities. It is not appropriate for an R&D environment. Conducting basic and applied research involves experimentation. Exploration of new methods and new technologies in these high-performance ventures, it is acceptable to take risks, to push the envelope, to fail. The tolerance of failure puts NASA and other R&D agencies into a different category than other federal agencies involved in the delivery of services to the public. Note, however, that this does not translate into an acceptance of failures that result from taking an inappropriate level of risk. The level of appropriate risk is tailored to the environment. The distinction is critical, particularly in high-value, high-cost environments, such as human space flight, the maintenance of the Hubble Space Telescope, and the launch of the Cassini spacecraft. The risk of failure in those venues is limited by all practicable means.

Thus, output measures are best used in suitable context. For these reasons, NASA management encourages Space Shuttle program managers to shunt aside metrics dealing with launches planned vs. launches achieved during a given fiscal year. If by waiting, one less launch is achieved than planned, but the result is better safety or quality or enables improved performance or reduces risk, then the latter result is what NASA wants to incentivize.

We have met with little success in past efforts to marry conventional output measures to these other parameters to derive a quantitative performance metric. Instead, we have determined that asking independent experts to review both quantitative and qualitative measures and to come up with an integrated score is a better approach.

For the purpose of assessing NASA's overall performance, we will continue to ask our Advisory Committees to evaluate accomplishments at the level of the Enterprise and Crosscutting Process objectives, integrating not only quantitative output measures but also balancing these in the context of safety, quality, high performance, and appropriate risk. The Advisory Committees will be asked to assign a rating of "red, yellow, or green" to measure the progress made against each of the objectives, and provide a narrative explanation. These objectives are identified in the Strategic Plan and repeated in the display of Strategic Goals and Strategic Objectives.

## Space Science Enterprise

### Mission

The primary Goal of the Space Science Enterprise is to chart the evolution of the universe from origins to destiny, and improve understanding of galaxies, stars, planets, and life (Figure 2). Within this Goal, Enterprise Objectives are to solve mysteries of the universe, explore the solar system, discover planets around other stars, and search for life beyond Earth. Other Enterprise Goals include developing innovative technologies to support Space Science programs and making them available for other applications that benefit the Nation. Enterprise missions and research also yield scientific information of value for future exploration programs. Knowledge and discoveries will be shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans.

### Implementation Strategy

The Space Science Enterprise is continuing to develop new programs through the “faster, better, cheaper” approach. Program managers are encouraged to shorten the development time of technologies and missions, explore new conceptual approaches, streamline management, and incorporate innovative methods and technologies to enhance efficiency and effectiveness while maintaining safety. Continuing investment in long-term, high-payoff technologies, such as advanced miniaturization, intelligent systems, autonomous operations, and simulation-based design, are key to implementing the Space Science mission. Collaborative efforts with other Federal agencies, such as the National Science Foundation, Department of Defense and Department of Energy, as well as with international partners, play a key role in the implementation strategy of the Enterprise.

### Enterprise Resource Requirements

The President has requested the following budget for FY99 to FY05 to support the accomplishment of Space Science goals:

	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
NOA \$M	2,119	2,193	2,399	2,606	2,961	3,299	3,578
CS FTEs	1,846	1,751	1,740	1,728	1,745	1,750	1,762

### Performance Measures

The following measures summarize individual targets and indicators for Enterprise programs:

**Goal: Chart the evolution of the universe from origins to destiny, and understand its galaxies, stars, and life.**

**Objective: Solve Mysteries of the Universe**

- Successfully develop and launch no less than three of four planned missions within 10% of budget and schedule; an example is the Microwave Anisotropy Probe (MAP) (Target: 1S1).
- Obtain expected scientific data from 80% of operating missions; examples are the Chandra X-ray Observatory (CXO) and the Far Ultraviolet Spectroscopy Explorer (FUSE) (Target: 1S2).
- Perform innovative scientific research and technology development by meeting technology development objectives for major projects (for example, the Next Generation Space Telescope, NGST), by achieving a mission success rate of 80% for astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs (Target: 1S3).

**Objective: Explore the Solar System**

(This objective includes missions to increase our understanding of the Sun and its effects on the Earth, as well as missions to explore the solar system.)

- Successfully develop and launch no less than one of two missions within 10% of budget and schedule; an example is the Mars 01 Orbiter (Target: 1S4).
- Obtain expected scientific data from 80% of operating missions; examples are the Cassini and Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) missions (Target: 1S5).
- Perform innovative scientific research and technology development by meeting technology development objectives for major projects (for example, the Solar-Terrestrial Relations Observatory, STEREO), by achieving a mission success rate of 80% for space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs (Target: 1S6).

**Objective: Discover Planets Around Other Stars**

- Perform innovative scientific research and technology development by meeting interferometry technology development objectives (for example, for the Space Interferometry Mission, SIM) and by making satisfactory research progress in related R&A programs (Target: 1S7).

**Objective: Search for Life Beyond Earth**

- Perform innovative scientific research and technology development by meeting technology development objectives for the Europa Orbiter and by making satisfactory research progress in the related R&A program, including the Astrobiology program (Target: 1S8).

**Goal: Contribute measurably to achieving the science, math, and technology education goals of our nation.**

**Objective: Make education and enhanced public understanding of science an integral part of our missions and research**

- Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs, including planning or implementing funded education and outreach activities in at least 34 states (Target: 1S9).

**Goal: Support human exploration through robotic missions.**

**Objective: Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies**

- Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching the Mars 01 Orbiter, by obtaining data from operational spacecraft (for example, the Mars Global Surveyor), and by making satisfactory progress in related R&A and DA programs (Target: 1S10).

**Objective: Develop the knowledge to improve the reliability of space weather forecasting**

- Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions (for example, the Transition Region and Coronal Explorer, TRACE) and by making satisfactory progress in related areas in R&A and DA programs (Target: 1S11).

**Goal: Develop new technologies needed to carry out innovative and less costly mission and research concepts**

**Objective: Develop new technologies needed to carry out innovative and less costly mission and research concepts**

- Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs (information systems, high performance computing, and Explorer program technology) and by making progress as planned in the Flight Validation program (Target: 1S12).

**NEW INITIATIVE**

**New Initiative: Living With a Star**

- Further understanding of basic natural processes and the effects of solar variability on humans and technology by achieving performance objectives for development of a strategic plan, completion of a mission definition study, and the initiation of targeted research and data analysis.

**Internal Assessment**

The Space Science program consists of numerous diverse components, and each component's performance must be assessed in an appropriate way. For some program elements, such as mission development, achievement of major milestones is easily identified through routine project management reviews. For missions in an operational phase, success can be gauged in terms of operating

efficiency or major data sets returned. For technology programs, progress can be predicted and measured in terms of technical capabilities achieved or successful laboratory or flight tests. In each of these cases, performance assessment data can be retrieved from normal project management reporting during the course of the fiscal year.

## **External Assessment**

For the basic research programs, evaluation must consider important contextual factors such as: the relative value of the research objectives; progress toward those objectives; productivity by prevailing research community standards; and impact on related research funded or performed by other agencies. Measures such as number of grants or scientists supported, publication counts, or research citations are not able to capture these important aspects of the evaluation requirement. The best way to assess research programs has been demonstrated to be an external peer review or visiting committee approach. The Enterprise will employ this mechanism to qualitatively assess the progress of its programs in basic research and data analysis against Enterprise strategic plan science goals and objectives. The reviews will determine whether these investigation programs are fully effective, are not as strong as desired but have returned results of significant value, or are not scientifically or technologically competitive. The review process will also identify those programs that have produced important unexpected results or have contributed to an unanticipated degree to other research.

### Space Science Enterprise FY 01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	#	FY01 Target	FY01 Indicator
Chart the evolution of the universe, from origins to destiny, and understand its galaxies, stars, and life	Solve Mysteries of the Universe	1S1	Successfully develop and launch no less than three of four planned missions within 10% of budget and schedule.	Performance indicators have been identified for four missions scheduled to launch in FY01; an example is the Microwave Anisotropy Probe (MAP). Indicators have also been established for other missions in development.
		1S2	Obtain expected scientific data from 80% of operating missions.	Performance indicators have been identified for six operating missions [examples are the Chandra X-ray Observatory (CXO) and the Far Ultraviolet Spectroscopy Explorer (FUSE)]. An indicator has also been established for another mission scheduled to launch in FY01; this indicator is to be utilized upon successful launch.
		1S3	Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs.	Performance indicators have been drawn from technology development objectives for three missions; an example is the Next Generation Space Telescope (NGST). Indicators have also been established for achievement of mission success for astronomy rocket and balloon flights and research progress in the R&A and DA programs.
	Explore the Solar System	1S4	Successfully develop and launch no less than one of two missions within 10% of budget and schedule.	Performance indicators have been identified for two missions scheduled to launch in FY01; an example is the Mars 01 Orbiter. Indicators have also been established for other projects in development.
		1S5	Obtain expected scientific data from 80% of operating missions.	Performance indicators have been identified for nine operating missions [examples are the Cassini and Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED) missions]. Indicators have also been established for other missions scheduled to launch in FY01; these indicators are to be utilized upon successful launch.
		1S6	Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs.	Performance indicators have been drawn from technology development objectives for three missions, as well as for future mission sets and for specific multi-mission technology development efforts. An example of the individual missions is the Solar-Terrestrial Relations Observatory (STEREO). Indicators have also been established for achievement of mission success for space physics rocket and balloon flights and research progress in the R&A and DA programs.
	Discover Planets Around Other Stars	1S7	Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs.	Performance indicators have been drawn from technology development objectives for three missions; an example is the Space Interferometry Mission (SIM). Indicators have also been established for the Keck Interferometer project and for achievement of research progress in the R&A program.

### Space Science Enterprise FY 01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	#	FY01 Target	FY01 Indicator
	Search for Life Beyond Earth	1S8	Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program.	Performance indicators have been drawn from the technology development objectives for the Europa Orbiter. Indicators have also been established for achievement of research progress in the R&A program, including especially the Astrobiology program.
Contribute measurably to achieving the science, math, and technology education goals of our nation.	Make education and enhanced public understanding of science an integral part of our missions and research	1S9	Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs.	Performance indicators have been identified for education and public outreach efforts. These indicators include the planning or implementation of funded education or outreach activities in at least 34 states.
Support human exploration through robotic missions	Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies	1S10	Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs.	Performance indicators have been identified for the Mars '01 Orbiter, scheduled to launch in FY01, and for a Discovery mission scheduled to be in development. Other indicators have also been identified for an operating mission, as well as for achievement of research progress in related R&A and DA programs.
	Develop the knowledge to improve the reliability of space weather forecasting	1S11	Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions and by making satisfactory progress in related areas in R&A and DA programs.	Performance indicators have been identified for four operating missions; an example is the Transition Region and Coronal Explorer (TRACE). Indicators have also been established for another mission scheduled to launch in FY01 (to be utilized upon successful launch), as well as for achievement of research progress in the R&A and DA programs.
Develop new technologies needed to carry out innovative and less costly mission and research concepts	Develop new technologies needed to carry out innovative and less costly mission and research concepts	1S12	Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs and by making progress as planned in the Flight Validation program.	Performance indicators have been identified for the space science core technology programs (information systems, high performance computing, and Explorer program technology), as well as for the Flight Validation program.
<i>New Initiative</i>	Living With a Star		Further understanding of basic natural processes and the effects of solar variability on humans and technology.	Performance indicators have been established for the development of the Living With a Star Strategic Plan, completion of a mission definition study, and the initiation of targeted research and data analysis.



<b>SSE FY01</b>	<b>Budget Category</b>	<b>SIRTF</b>	<b>HST Development</b>	<b>GP-B</b>	<b>SOFIA</b>	<b>Payloads</b>	<b>Explorers</b>	<b>Discovery</b>	<b>Mars Surveyor</b>	<b>Operating Missions</b>	<b>SR&amp;T</b>
<b>Performance Target</b>											
<i>Solve Mysteries of the Universe:</i> Successfully develop and launch no less than three of four planned missions within 10% of budget and schedule. (1S1)		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>				
<i>Solve Mysteries of the Universe:</i> Obtain expected scientific data from 80% of operating missions. (1S2)										<b>X</b>	
<i>Solve Mysteries of the Universe:</i> Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs. (1S3)											<b>X</b>
<i>Explore the Solar System:</i> Successfully develop and launch no less than one of two missions within 10% of budget and schedule. (1S4)						<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>		
<i>Explore the Solar System:</i> Obtain expected scientific data from 80% of operating missions. (1S5)										<b>X</b>	
<i>Explore the Solar System:</i> Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs. (1S6)											<b>X</b>
<i>Discover Planets Around Other Stars:</i> Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs. (1S7)											<b>X</b>
<i>Search for Life Beyond Earth:</i> Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program. (1S8)											<b>X</b>
<i>Make Education and Enhanced Public Understanding of Science an Integral Part of our Missions and Research:</i> Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs. (1S9)		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<i>Investigate the Composition, Evolution, and Resources of Mars, the Moon, and Small Bodies:</i> Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs. (1S10)								<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<i>Develop the Knowledge to Improve the Reliability of Space Weather Forecasting:</i> Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions and by making satisfactory progress in related areas in R&A and DA programs. (1S11)										<b>X</b>	<b>X</b>
<i>Develop New Technologies Needed to Carry Out Innovative and Less Costly Mission and Research Concepts:</i> Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs and by making progress as planned in the Flight Validation program. (1S12)											<b>X</b>
<i>Living With a Star (New Initiative):</i> Complete Living With a Star Strategic Plan, including mission architecture, for the OSS Strategic Plan, complete a mission definition study, and initiate targeted research and data analysis.											<b>X</b>

## **Earth Science Enterprise**

### **Mission**

The Earth Science Enterprise (ESE) mission is to understand the total Earth system and the effects of natural and human-induced changes on the global environment. The programs of the ESE advance the new discipline of Earth System Science, with a near-term emphasis on global climate change. Both space and ground-based capabilities yield new scientific understanding of Earth and practical benefits to the Nation. The research results will contribute to the development of environmental policy and economic investment decisions. The ESE mission includes the development of innovative technologies to support Earth Science programs and make them available for solving practical societal problems in agriculture and food production, water resources, and national resource management that provide benefits to the Nation. Knowledge and discoveries will be shared with the public to enhance science, mathematics, and technology education as well as increase the scientific and technological literacy of all Americans.

### **Implementation Strategy**

The ESE conducts global and regional research requiring the vantagepoint of space. New programs will be developed and deployed through the "faster, better, cheaper" approach. Program managers are encouraged to accept prudent risk, shorten development time of technologies and missions, explore new conceptual approaches, streamline management, and incorporate innovative methods to enhance efficiency and effectiveness. Programs of the ESE contribute to the U.S. Global Change Research Program (USGCRP) and are conducted in collaboration with ten other U.S. Federal agencies and 13 nations. Cooperative research programs with national and international partners will continue to play a key role in the implementation strategy of the ESE.

The same spirit of innovation that embodies the Earth Science flight programs applies to technology development. Long-term, high-risk, high-payoff technologies are key to implementing the Earth Science mission. The ESE priorities feature near-term product milestones on a path of long-term inquiry. Obtaining data from the private sector is an emerging feature of the ESE strategy. This will reduce Agency costs and encourage the growth of the commercial remote-sensing industry.

ESE's first Science Research Plan, published in 1996, laid out a strategy for study in five Earth system science areas of maturing scientific understanding and significant societal importance: land-cover and land use changes; short-term climate events, natural hazards research and applications; long-term climate change research; and atmospheric ozone research. The plan also outlined some twenty related areas of research, which underlie these themes and round out the Earth Science contribution to Earth system science. The National Research Council (NRC) recognized the complexity of global Earth environment issues, the multiplicity of interactions between component processes and the cross-disciplinary connections they evoke (Research Pathways for the Next Decade-Overview; NRC, 1998). In the face of such complexity, the NRC outlined a diversity of unsolved scientific questions that call for further study, but also emphasized the need for a focused scientific strategy, concentrating efforts and resources on critical scientific problems that are most relevant to national policy issues. Responding to the latter recommendation, the ESE is pursuing a targeted research program, focused on an updated set of specific science questions that can be addressed effectively with NASA's capabilities, and formulating comprehensive research strategies that can lead to definitive scientific answers, as well as effective applications for all citizens.

The key research topics studied by NASA's ESE fall largely into three categories: forcings, responses, and the processes that link the two and provide feedback mechanisms. This conceptual approach applies in essence to all research areas of NASA's Earth Science program, although it is particularly relevant to the problem of climate change, a major Earth Science-related issues facing the countries of the world. The ESE has articulated a set of science questions which its observational programs and research, modeling, and analysis activities are directed at answering.

How does the Earth change naturally?

What are the primary forcings of the Earth system by human activities?

How does the Earth system respond to natural and human-induced changes?

What are the consequences of changes in the Earth system for human civilization?

How can we predict the changes in the Earth system that will take place in the future?

These questions will be addressed by a research community organized around science disciplines reflecting Earth system components undergoing and responding to change (e.g. the chemistry of the atmosphere and the biogeochemistry of the global carbon cycle).

## Enterprise Resource Requirements

The President has requested the following budget for FY99 to FY05 to support the accomplishment of ESE goals:

	<b><u>FY 1999</u></b>	<b><u>FY 2000</u></b>	<b><u>FY 2001</u></b>	<b><u>FY 2002</u></b>	<b><u>FY 2003</u></b>	<b><u>FY 2004</u></b>	<b><u>FY 2005</u></b>
RY\$M	1,414	1,443	1,406	1,333	1,293	1,303	1,306
CS FTE	1,365	1,382	1,419	1,424	1,417	1,431	1,436

## **Performance Measures**

### **Goal: Expand scientific knowledge by characterizing the Earth system.**

#### **Objective: Successfully launch spacecraft.**

- Target: The ESE will successfully develop, have ready for launch, and operate instruments on at least two spacecraft within 10 percent of their schedules and budget to enable Earth Science research and applications goals and objectives. 1Y1

### **Goal: Disseminate information about the Earth system.**

#### **Objective: Implement open, distributed, and responsive data system architecture.**

The dissemination of information resulting from Earth Science research is accomplished through the Earth Observing System Data and Information System (EOSDIS), and will continue to be a high priority in FY01. Distribution systems will be improved and new methods will be developed to place data in the hands of Earth Science customers in a timely manner through open, distributed, and responsive data system architectures.

Performance target will be to:

- Target: Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. Indicators of this activity will be to increase by 20 percent the volume of climate data archived over the FY00 target of 368 terabytes, increase the number of products delivered from the DAAC archives by 10 percent over FY00, and make the data available to users within five days. 1Y2

### **Goal: Expand scientific knowledge by characterizing the Earth system.**

**Objective: Understand the causes and consequences of land-cover/land-use change** - determining how land cover and climate changes affect agricultural productivity and terrestrial and marine ecosystem health.

The carbon cycle is one of the major Earth system processes influencing global climate. NASA research on the biology and biogeochemistry of ecosystems and the global carbon cycle aims to understand and predict how terrestrial and marine ecosystems are changing. This research theme addresses ecosystems as they are affected by human activity, as they change due to their own intrinsic biological dynamics, and as they respond to climatic variations and, in turn, affect climate. Emphasis is on understanding the processes of the Earth system that affect its capacity for biological productivity and the role of the biosphere in Earth system function. Understanding the distribution and cycling of carbon among the active land, ocean, and atmospheric reservoirs constitutes a major scientific focus for research.

The performance targets will be to:

- Target: Explore the dynamics of the global carbon cycle by developing, analyzing, and documenting at least three multi-year data sets. An example of this will be developing a global time series of phytoplankton biomass and primary productivity in the oceans. 1Y3
- Target: Explain the dynamics of global carbon cycle by building improved models and prediction capabilities. One indicator of this activity is improving ecological models needed to predict ecosystem responses to global environmental changes by 15 percent. 1Y4

**Objective: Predict seasonal-to-interannual climate variation** - determining how water cycles among land, oceans and atmosphere and its impacts on fresh water availability.

Ascertaining the rate of cycling of water in the Earth system, and detecting possible changes, is a first-order problem with regards to the issue of renewal of water resources. Current ESE program activities in this area are; establishing the existence (or absence) of a trend in the rate of the global water cycle, investigating the relationships between large-scale climate anomalies and weather patterns, and accurately representing the integrated effect of water vapor absorption and clouds in a way that is suitable for use in models of climate. The overarching goal is to improve the understanding of the global water cycle to the point at which useful predictions of regional hydrologic regimes can be made. This predictive capability is essential for practical applications to water resource management and for validating scientific advances through the test of real-life prediction.

In FY01 the ESE will continue to invest in observations, research, data analysis, and modeling in this area. The Tropical Rainfall Measuring Mission (TRMM), launched in 1997, will continue to gather information on rainfall in the tropics where two-thirds of global precipitation falls. This is the key to understanding Earth's hydrological cycle, one of the three major processes driving climate change and the global heat balance which drives seasonal change. Current uncertainty in global tropical rainfall estimates is 50 percent; TRMM data will reduce this uncertainty to 10 percent, an 80 percent improvement.

The performance targets will be to:

- Target: Explore the dynamics of global water cycle by developing, analyzing, and documenting at least one multi-year data set such as that needed to obtain accurate maps of the sunrise to sunset changes in precipitation. 1Y5
- Target: Explain the dynamics of global water cycle by building improved models and prediction capabilities, specifically improving current understanding of the large-scale effects of clouds in climate. 1Y6

**Objective: Detect long-term climate change, causes, and impacts** - understanding, modeling and predicting near and long-term climate variability at global and regional scales.

Climate is not perceived as a static property of the environment any more, but rather a dynamic state that is expected to evolve in the future. This research theme focuses on the modes of variability that involve in a fundamental way the dynamics of the slower components of the physical climate system, the ocean circulation and the mass balance of polar ice sheet. These components respond to disturbances with greater inertia, and therefore longer "memories", than the atmosphere. Currently the ESE research

seeks to; understand the mechanisms of climate variability and predict future transient variations, assess the response of the Earth climate to changes in external forcing factors or surface boundary conditions, and assess the current mass balance of polar ice-sheets and potential future changes, including effects on sea level.

The performance targets will be to:

- Target: Explore the dynamics of long term climate variability by developing, analyzing, and documenting at least two multi-year data sets. An example is continuing the high precision, multi-decadal record of total solar irradiance, providing a quantitative understanding of the solar forcing effects on Earth's climate. 1Y7
- Target: Explain the dynamics of long term climate variability by building improved models and prediction capabilities. One example of this activity will be demonstrating experimental seasonal climate predictions by using next generation super computing systems and new-coupled air-ocean-land-ice models. 1Y8

**Objective: Understand the causes of variation in atmospheric ozone concentration and distribution** - monitoring and predicting how atmospheric composition is changing in response to natural and human-induced factors.

Atmospheric change is the result of strongly interactive chemical and physical processes. Chemistry plays a role in determining weather and climate, while the physics and dynamics of the atmosphere influence chemical processes and composition. The goals of the Atmospheric Chemistry Research Program are to measure and understand how atmospheric composition is changing in response to natural and anthropogenic forcings, and enable accurate prediction of future changes in ozone and surface ultraviolet radiation, climate forcing factors, and global pollution.

The performance targets will be to:

- Target: Explore the dynamics of atmospheric composition by developing, analyzing, and documenting at least three multi-year data sets, such as providing continuity of multi-decadal total ozone concentration measurements. 1Y9
- Target: Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities. One example of this activity will be characterizing the atmospheric plume flowing out of East Asia, its evolution as it transits eastward over the Pacific, and its contribution to global atmospheric chemical composition. 1Y10

**Objective: Identify natural hazards, processes, and mitigation strategies** - discovering the nature and processes of the Earth's dynamic interior and crust to better prepare for natural hazards.

The long-standing Earth Science Research Program in fundamental solid Earth Science explores issues such as the dynamics of the Earth's interior and crust, tectonic motions, earthquakes, volcanic eruptions, and the evolution of landscapes. Results of this and other relevant activities are developed and applied to the assessment and mitigation of natural disasters for the practice of disaster management, working together with practitioners at the international, federal, state and local levels. Through the development of technologies designed to observe and understand the Earth, the ESE possesses an inventory of observational capabilities and techniques which can be developed and applied to understanding natural hazards, characterizing natural disasters, and monitoring conditions that may lead to such events.

The ESE will use a combination of space-based and airborne assets to monitor and assess impacts of natural hazards such as volcanoes, earthquakes, forest fires, hurricanes, floods and droughts. The short-term objective is to assess impacts of these events on national and international agriculture, food production, water resources, commerce, etc. The long-term objective is to apply the scientific understanding toward developing a predictive capability.

In FY01 the ESE will continue to provide the technology and instruments to allow collection of interferometric Synthetic Aperture Radar (SAR) data. This will enable the first consistent global topography data record collected from space, and will have a variety of applications including flood hazard assessment, laying out new roadways and pipelines, and providing airline operators with detailed elevation data for remote areas.

The performance targets will be to:

- Target: Explore the dynamics of the Earth's interior and crust by developing, analyzing, and documenting at least one multi-year data set such as analysis of 30 meter topographic data for global geological and geomorphic process studies and improved mapping of terrain features. 1Y11
- Target 1Y12: Explain the dynamics of the Earth's interior and crust by building improved models and prediction capabilities. An indicator of this activity will be providing a basis for future tectonic modeling and earthquake vulnerability assessment through completion of the Southern California Integrated GPS network. 1Y12

**Goal: Enable the productive use of ESE science and technology in the public and private sector.**

**Objective: Develop and transfer advanced remote sensing technologies.**

In collaboration with partners in industry and academia, the ESE will develop and demonstrate new technologies of value to remote-sensing research.

The performance target will be to:

- Target: Achieve success in timely development and infusion of technologies. This will be accomplished by formal technology readiness assessment of critical technology essential for implementing proposed mission concepts. The Technology Readiness levels (TRLs) will be such that the mission development cycle can be accomplished within a 3-year cycle. This activity will enable future science missions by increasing technology readiness for mission concepts to reduce their total cost. An example indicator is the transfer at least one technology development to a commercial entity for operational use. 1Y13

**Objective: Extend the use of Earth Science research for national, state, and local applications.**

Because the ESE addresses science questions of societal importance, the research performed also leads to practical applications. ESE works with National, State, and local government entities to help them develop remote sensing applications products to address issues of importance to them. These include agricultural productivity, natural resources management, as well as urban and regional planning.

The performance targets will be to:

- Target: Provide regional decision-makers with scientific and applications products/tools. An example indicator is an effort with USGS, to produce a new Landsat-7 based map of each of the 50 states for their use in communicating geographic information. 1Y14
- Target: Improve access to and understanding of remotely sensed data and processing technology. An example indicator is putting on informational workshops in using Earth Science observations and information involving at least 20 states. 1Y15



**Objective: Support the development of a robust commercial remote sensing industry.**

NASA is committed to a growing relationship with the commercial remote sensing industry to enhance the utility of Earth Science information in the U.S. economy. Commercial firms are both potential sources of science-quality remote sensing data, and producers of “value-added” information products from U.S. research satellites.

The performance targets will be:

- Target: Stimulate the development of a robust commercial remote sensing industry. An example indicator is developing ten new commercial products in joint commercial applications research projects. 1Y16
- Target: Increase efficiencies in food and fiber production with the aid of remote sensing by conducting at least 20 joint applications research endeavors in conjunction with the U.S. Department of Agriculture. 1Y17

**Objective: Increase public understanding of Earth System through education and outreach.**

Earth Science missions and research programs make a unique contribution to education and the public understanding of Earth Science. They provide a steady return of discoveries and new knowledge contributes to the accomplishment of this objective. The ESE will continue to sponsor research awards through NASA's Graduate Student Research Program.

The performance target will be to:

- Target: Increase public understanding of Earth system science through formal and informal education. The ESE will continue and improve upon prior year performance in the areas of graduate research and education grants, K-12 teacher workshops, and participation in GLOBE. 1Y18

**Objective: Make major scientific contributions to national and international environmental assessments.**

Because of the nature of the discipline, it is vital that Earth Science research be conducted through cooperation and partnerships with other agencies and with other countries. The ESE will continue to contribute scientific knowledge and observations and modeling results to national and international scientific environmental assessments. The targets for this objective are embedded within targets in other program areas.

## **Internal Assessment**

The Earth Science Enterprise will regularly review performance objectives as part of our existing monthly review process. Using a database to track current performance monthly for each specific FY01 target will enable the Enterprise to focus on targets that need improvement. ESE management will institute measures to ensure improvement.

As ESE is a scientific endeavor, many of its measures involve scientific results. These are subject to peer review, both in the selection of the science investigation, and in the reporting of findings in the scientific literature. Where the metric is production of a data product, these must be archived in ESE's information system, where their availability can be confirmed via an Internet query. Metrics addressing scientific assessment activities result in formal, published reports that are readily identified.

## **External Assessment**

The Earth Science Advisory Committee of the NASA Advisory Council will conduct an annual assessment of the ESE's near-term science objectives. The Committee will provide a qualitative progress measurement (Green, Yellow, or Red). "Green" will indicate that the objective was met; "Yellow" will indicate a concern that an objective was not fully accomplished; and "Red" will indicate that events occurred that prevented or severely impaired the accomplishment of the objective. The assessment will include commentary to clarify and supplement the qualitative measures.

Earth Systems Science and Application Advisory Committee (ESSAAC) is a committee of the NASA Advisory Council under the Federal Advisory Committee Act, and comprises outside scientific and technical experts from academia, industry, and other government agencies. ESSAAC meets at least twice a year to review plans and progress in the ESE. After the end of each fiscal year, the ESE will provide ESSAAC a self-assessment in each of the relevant objectives, highlighting performance against the metrics in the Performance Plan for that year. ESSAAC will deliberate internally and render its own assessment, which may confirm or modify the ESE's self-assessment. ESSAAC's assessment will be reported in the Performance Report for that year. This process will be repeated annually.

### Earth Science FY01 Performance Plan

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>O1 #</b>	<b>FY01 Targets</b>	<b>FY01 Indicators</b>
<b>Expand scientific knowledge by characterizing the Earth system.</b>	<b>Successfully launch spacecraft</b>	1Y1	Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives.	Accomplish target within 10% of schedule and budget. At least 90% of the on-orbit instrument complement fully operational.
<b>Disseminate information about the Earth system.</b>	<b>Implement open, distributed, and responsive data system architecture.</b>	1Y2	Successfully disseminate Earth Science data to enable our science research and applications goals and objectives.	Increase by 20% the volume of climate data archived, increase the number of products delivered from the DAAC archives by 10%, and make available acquired observations and resulting information to users within 5 days of acquisition.
<b>Expand scientific knowledge by characterizing the Earth system.</b>	<b>Understand the causes and consequences of land-cover/land-use change.</b>	1Y3	Explore the dynamics of the global carbon cycle by developing, analyzing, and documenting multi-year data sets.	Develop, analyze, and document at least three multi-year data sets.
		1Y4	Explain the dynamics of global carbon cycle by building improved models and prediction capabilities.	Improve by at least 15% the ecological models and provide information to understand remotely sensed observations.
	<b>Predict seasonal-to-interannual climate variations.</b>	1Y5	Explore the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets.	Develop, analyze, and document at least one multi-year data sets. Decrease the uncertainty by at least 20% in determinations of radiation forcing and feedback.
		1Y6	Explain the dynamics of global water cycle by building improved models and prediction capabilities.	Complete collection and processing of satellite data needed for the multi-decadal global cloud climatology, validate parameterizations of Earth's radiative processes, and demonstrate the capability to measure and diagnose soil moisture remotely from airborne platforms.
	<b>Detect long-term climate change, causes, and impacts.</b>	1Y7	Explore the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets.	Develop, analyze, and document at least three multi-year data sets.
		1Y8	Explain the dynamics of long term climate variability by building improved models and prediction capabilities.	Develop and demonstrate the capability to measure and diagnose open ocean variations in salinity by 0.1 psu. Develop and validate aerosol retrieval and cloud screening algorithms, and processing of satellite data and transport model evaluations. Demonstrate the experimental seasonal climate predictions.
	<b>Understand the causes of variation in atmospheric ozone concentration and distribution.</b>	1Y9	Explore the dynamics of atmospheric composition by developing, analyzing, and documenting multi-year data sets.	Develop, analyze, and document at least three multi-year data sets.
		1Y10	Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities.	Provide increased prognostic ability for Northern hemisphere high latitude ozone loss, develop the first global climatology of carbon monoxide and total column methane, and characterize atmospheric plume flowing out of East Asia, its evolution, and its contribution to global atmospheric chemical composition.

### Earth Science FY01 Performance Plan

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>01 #</b>	<b>FY01 Targets</b>	<b>FY01 Indicators</b>
	<b>Identify natural hazards, processes, and mitigation strategies.</b>	1Y11	Explore dynamics of the Earth's interior and crust by developing, analyzing, and documenting multi-year data sets.	Develop, analyze, and document at least one multi-year data set.
		1Y12	Explain dynamics of the Earth's interior and crust by building improved models and prediction capabilities.	Improve understanding of geodynamic processes, allow continuous observations, improved data processing efficiency, and reduce operational costs by 20%. Provide a basis for future tectonic modeling and earthquake vulnerability assessment.
<b>Enable the productive use of ESE science and technology in the public and private sectors.</b>	<b>Develop and transfer advanced remote-sensing technologies.</b>	1Y13a-c	<b>Achieve success in timely development and infusion of technologies.</b> Enable future science missions by increasing technology readiness for mission concepts to reduce their total cost.	Advance at least 25% of funded instrument technology developments one Technology readiness level (a). Develop advanced information systems technologies and concepts (b). Develop at least 3 technologies to demonstrate them in space with the third Earth Observer New Millennium satellite (c). Transfer at least one technology development to a commercial entity for operational use.
	<b>Extend the use of Earth science research to regional, state, and local applications.</b>	1Y14	Provide regional decision-makers with scientific and applications products/tools.	Establish at least a second Regional Earth Science Application Center (RESAC) as a self-sustaining entity. Produce a digital image database of all 50 states once every two years. Develop capability to assess the vulnerability of fishing grounds due to water quality issues. Develop experimental models to demonstrate an ability to improve forecast skill levels. Monitor and predict the track of at least one key atmospheric pollutant species. Develop a prototype air quality assessment. Initiate two Applications Research projects with the public and private sector. Develop a predictive capability for outbreaks of malaria with 50% accuracy in Central Africa. Develop at least two new data products for routine decision-making.
		1Y15	Improve access to and understanding of remotely sensed data and processing technology.	Involve at least 20 states in informational workshops to foster applications of remote sensing data and processing technology. Initiate at least 10 joint Application Research pilot projects. Implement at least 10 active student internships at the State and local level.
	<b>Support the development of a robust commercial remote sensing industry.</b>	1Y16a	Stimulate the development of a robust commercial remote sensing industry.	Develop 10 new market commercial products. Identify at least one new commercial source of science. Develop 4 new validated commercial information products. Provide 10 prototype products that quantify the utility of Hyperspectral and Synthetic Aperture Radar (SAR) technologies and define future market requirements. Increase cost share leveraging with companies, academia, and other government agencies by 10%.
		1Y17	Increase efficiencies in food and fiber production with the aid of remote sensing.	Conduct at least 30 joint applications research endeavors in conjunction with the U.S. Dept of Agriculture

### Earth Science FY01 Performance Plan

<b><u>Strategic Plan Goal</u></b>	<b><u>Strategic Plan Objective</u></b>	<b><u>01 #</u></b>	<b><u>FY01 Targets</u></b>	<b><u>FY01 Indicators</u></b>
	<b>Increase public understanding of earth system science through education and outreach.</b>	1Y18	Increase public understanding of Earth system science through formal and informal education.	Continue 90 existing grants and award 50 new graduate student research and education grants. Continue 17 early career grants in research/education and initiate at least two new collaborative projects. Conduct at least 400 workshops training K-12 teachers. Increase participating teachers in Global Learning and Observation to Benefit the Environment (GLOBE) to 13,800 and increase participating countries to 87.

<b>ESE FY01</b>	<b>Budget Category</b>	<b>EOS</b>	<b>Earth probes</b>	<b>Operations</b>	<b>Research and Technology</b>
<b>Performance Target</b>					
Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives. (1Y1)		<b>X</b>	<b>X</b>	<b>X</b>	
Successfully disseminate Earth Science data to enable our science research and applications goals and objectives. (1Y2)		<b>X</b>			
Explore the dynamics of the global carbon cycle by developing, analyzing, and documenting multi-year data sets. (1Y3)		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Explain the dynamics of global carbon cycle by building improved models and prediction capabilities. (1Y4)		<b>X</b>			<b>X</b>
Explore the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets. (1Y5)		<b>X</b>		<b>X</b>	<b>X</b>
Explain the dynamics of global water cycle by building improved models and prediction capabilities. (1Y6)		<b>X</b>			<b>X</b>
Explore the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets. (1Y7)		<b>X</b>			<b>X</b>
Explain the dynamics of long term climate variability by building improved models and prediction capabilities. (1Y8)		<b>X</b>		<b>X</b>	<b>X</b>
Explore the dynamics of atmospheric composition by developing, analyzing, and documenting multi-year data sets. (1Y9)		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities. (1Y10)		<b>X</b>			<b>X</b>
Explore the dynamics of the Earth's interior and crust by developing, analyzing, and documenting multi-year data sets. (1Y11)					<b>X</b>
Explain the dynamics of the Earth's interior and crust by building improved models and prediction capabilities. (1Y12)					<b>X</b>
Achieve success with timely development and infusion of technologies. Enable future science missions by increasing technology readiness for mission concepts to reduce their total cost. (1Y13)					<b>X</b>
Provide regional decision-makers with scientific and applications products. (1Y14)		<b>X</b>		<b>X</b>	<b>X</b>
Improve access to and understanding of remotely sensed data and processing technology. (1Y15)					<b>X</b>
Stimulate the development of a robust commercial remote sensing industry. (1Y16)					<b>X</b>
Reduce uncertainties in food and water production that are due to remote sensing. (1Y17)					<b>X</b>
Increase public understanding of Earth system science through formal and informal education. (1Y18)					<b>X</b>

# **Human Exploration and Development of Space**

## **Mission**

The Human Exploration and Development of Space (HEDS) Enterprise mission is to open the space frontier by exploring, using, and enabling the development of space to expand the human experience into space and bring the benefits of space to Earth. The Enterprise mission includes the development of innovative technologies to support HEDS programs and make them available for other applications that provide benefits to the Nation. Knowledge and discoveries will be shared with the public to enhance science, mathematics, and technology education and increase the scientific and technological literacy of all Americans.

## **Implementation Strategy**

The HEDS Enterprise strategy is integrated and implemented by two program offices: the Office of Space Flight (OSF) and the Office of Life and Microgravity Sciences and Applications (OLMSA).

The OSF strategy to contribute to the HEDS mission is focused on providing the infrastructure to enable research, exploration, and development, and consists of four major components: ensure safe, reliable and affordable access to space; establish permanent human presence aboard an earth-orbiting research laboratory; provide a space operations infrastructure; and expand the commercial development of space. To ensure safe, reliable and affordable access to space, safety investments provide for the modifications and improvements of the Space Shuttle and ground facilities through replacement of obsolete systems and expansion of safety and operating margins. Investments are also made in Space Shuttle operations including hardware production, ground and payload processing, launch and landing operations, flight crew operations, training, logistics, sustaining engineering, and in support of agency-wide needs for expendable launch vehicle (ELV) services. The implementation strategy for establishing permanent human presence in space is encompassed in the International Space Station (ISS) program. Assembly began with the November 1998 launch of the U.S.-owned/ Russian-launched functional cargo block (FGB) and permanent human presence should begin this year, as assembly continues. A space operations infrastructure that supports agency-wide operations is provided, and innovative approaches to expanding the commercial development of space are being pursued.

The OLMSA strategy to contribute to the HEDS mission is focused on conducting three types of research and technology development: fundamental, mission-driven, and application-driven research. OLMSA supports fundamental research driven by an emphasis on expanding scientific knowledge. Its focus on mission-driven research improves knowledge and technology for human space flight. The application-driven research of OLMSA seeks to transfer knowledge, expertise, and technology from HEDS missions to other uses that provide benefits to the Nation.

## Enterprise Resource Requirements

The President has requested the following budget for FY99 to FY05 to support the accomplishment of HEDS goals:

	<u>FY 1999</u>	<u>FY2000</u>	<u>FY 2001</u>	<u>FY2002</u>	<u>FY2003</u>	<u>FY2004</u>	<u>FY2005</u>
RY\$M	5,744	5,742	5,802	5,688	5,243	5,141	5,012
CSFTE	5,364	5,294	5,627	5,539	5,382	5,170	4,967

## Performance Measures

### Goal: Expand the Space Frontier.

#### Objective: Expand human exploration through collaborative robotic missions

- Target: Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 orbiter and lander missions. HEDS research planned for the mission includes radiation monitoring, soil and dust analysis, and an experiment on the production of propellants from the Martian atmosphere. 1H1

#### Objective: Define innovative human exploration mission approaches

- Target: Complete initial next decade planning mission architecture studies and technology plans. Architecture studies support near-term technology investment decisions to create building blocks that may enable a range of long-term planning options for future missions of exploration. 1H2

#### Objective: Invest in enabling high-leverage technologies

- Target: Initiate the HEDS Technology/Commercialization program and establish a synergistic relationship with industry. Indicator is a successful response to the initial NASA Research Announcement, with a 50% cost share from industry, where appropriate. 1H32



**Goal: Expand Scientific Knowledge.**

**Objective - In partnership with the scientific community, use the space environment to investigate chemical, biological and physical systems.**

- Target: Support an expanded, productive research community to include 975 investigations annually by 2001. HEDS seeks to prepare and support a research community to take full advantage of research opportunities in the coming era of orbital research, including support for 975 investigations in 2001. 1H3
- Target: Conduct outstanding peer-reviewed and commercial research on STS 107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion. 1H4
- Target: Begin research on the International Space Station. HEDS will increase fundamental knowledge and address critical questions in crew health and safety by conducting six to ten investigations on the International Space Station. Other investigations will include research on the behavior of colloids as a first step in the synthesis of new materials from colloidal particles, and detailed measures of the acceleration environment on ISS for use in planning future research. 1H5

**Goal: Enable and establish a permanent and productive human presence in Earth orbit.**

**Objective: Provide safe and affordable access to space.**

- Target: The Office of Space Flight will expedite a safety improvement program to ensure the continued safe operations of the Space Shuttle. The performance target is to have in place a Shuttle upgrade program that ensures the availability of a safe and reliable Shuttle system to support Space Station Assembly milestones and operations. The FY 2001 indicators include completion of the Checkout and Launch Control System applications software for the Orbiter Processing Facilities. All safety improvements are planned to be in place by 2005. 1H6
- Target: The Office of Space Flight continues to invest in Space Shuttle operations. Investments include hardware production, ground processing, launch and landing operations, flight crew operations, training, logistics, and sustaining engineering. The performance target is to achieve 8 or fewer flight anomalies per mission. 1H7

The Shuttle program uses safety/reliability and stability/schedule indicators. The Space Flight Operations Contractor, United Space Alliance, is subject first to an incentive safety/reliability gate, after which come various stability/schedule indicators like the one presented here. The FY 2001 indicator is to measure (post flight) the number of vehicle flight anomalies.

- Target: Achieve 100% on-orbit mission success. This target will be measured against the customer's mission objectives and the post-flight reporting of completion of mission objectives. 1H30

**Objective: Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives**

- Target: Development, manufacture and test of the ISS vehicle elements are phased in conjunction with the launch and on-orbit assembly schedule. The performance target is to successfully complete the majority of the planned development schedules and milestones required to support the Multi-element Integration Testing (MEIT). 1H10

MEIT tests perform integration testing with several launch elements to increase on-orbit confidence. The FY 01 indicator will include completion of MEIT to include flight elements for assembly flights 8A through 12A. This will be measured by completion of five-planned test configurations.

- Target: Deployment of the ISS occurs with on-orbit assembly over several years. Successful and timely deployment is dependent on the Shuttle and other international launch vehicles, and the provision of some elements and services from international partners and participants. The performance target is to successfully complete the majority of the ISS planned on-orbit activities such as delivery of mass to orbit and enhanced functionality. 1H11

FY01 indicators will include expansion of the capabilities of the ISS through launch and delivery of 180,000 lbs. of hardware and logistics to the ISS; and initiation and demonstration of ISS Extravehicular Activity (EVA) capability to support up to 30 EVAs annually from the U.S. Airlock. This will be measured by completion of a minimum of 5 EVAs from the ISS Airlock.

- Target: Operations of the ISS occur as the vehicle is being developed and assembled. The performance target to successfully complete the majority of combined ISS planned operations schedules and milestones as represented by permanent human on-orbit operations. 1H12

FY01 Indicators will include the presence of permanent human on-orbit operations with an estimated 8,000 crew hours dedicated to assembly, vehicle operations and payload operation.

- Target: The conduct of research is an important objective of the ISS. During assembly, the ISS will add pressurized volume, experiment racks, facilities and unpressurized payload accommodations in support of research opportunities. The performance target is to successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities. 1H13

FY 01 Indicators will include initiation of on-orbit research in the U.S. Laboratory focusing on early payload opportunities in the Human Research Facility (HRF-1) and multipurpose EXPRESS Racks.

- Target: The ISS program has undertaken a series of selected developments and support activities to enhance the robustness of the vehicle, enhance safety and reduce reliance on capabilities contributed by Russia. The performance target is to successfully complete no less than 85% of the planned Russian Program Assurance schedules and milestones required for the development of the Propulsion Module. 1H14

FY01 indicators will include initiation of Propulsion Module fabrication/assembly/integration and testing in preparation for launch in late FY 2002. This will be measured by completion of schedule milestones.

- Target: Crew transportation and return for up to three crewmembers is planned to be provided by Russia throughout the life of the program. In order to further enhance ISS safety, NASA has initiated the Phase 1 development of a crew return vehicle (CRV) that could provide the U.S. crew return capability to support the emergency return of up to seven crew, the full crew complement planned for the ISS. A U.S. crew return capability is planned for deployment late in the ISS assembly sequence. The performance target is to successfully complete no less than 75% of the planned crew return capability schedules. FY01 indicators will include accomplishment of program schedule milestones for Phase 1 development of a crew return vehicle (CRV) that could provide the U.S. crew return capability. 1H15

**Objective: Ensure the health, safety and performance of humans living and working in space**

- Target: Develop new biomedical and technological capabilities to facilitate living and working in space and return to Earth. HEDS will flight test a new method for reducing the risk of kidney stone formation and develop two new evidence-based countermeasure candidates ready for evaluation. 1H17
- Target: Develop and demonstrate technologies for improved life support systems. HEDS will demonstrate, in ground test, technologies that could reduce up to 25% of life support logistics over ISS baseline as determined by the detailed calculation of a life support equivalent system mass index and place online for review and comment. Equivalent system mass index is a measure of the performance of a life support system incorporating demonstrated technologies. Performance improves as improved technologies are demonstrated. 1H18
- Target: Initiate implementation of the Bioastronautics Initiative. The bioastronautics initiative will enhance activities already underway in order to ensure the health, safety, and performance of humans in space by accelerating research and development of "countermeasures" (diagnostics, therapy, preventatives, and rehabilitation methods) to maintain the health of flight crews on long duration missions and transfer this knowledge and technology to benefit health on Earth. Bioastronautics research is an interdisciplinary set of focused research activities bringing together biology, physics, chemistry, communications technology and nano-technologies that will revolutionize medical care delivery in space and on Earth. Indicators for FY 01 will include initiating a NASA/NCI collaboration to develop minimally invasive technologies and approaches for detecting and interpreting biological signatures that signal the emergence of disease. 1H31

**Objective: Meet sustained space operations needs while reducing costs.**

- Target: Increase the percentage of the space operations budget allocated to acquisition of communications and data services from the commercial sector to 15% in FY 2001. The space Communications Program will conduct tasks that enable commercialization and will minimize investment in government infrastructure for which commercial alternatives are being developed. 1H20

- Target: Achieve at least 95 percent of planned data delivery from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operations requirements in project service level agreements. 1H21

### **Goal: Expand the Commercial Development of Space.**

**Objective: Facilitate access to space for commercial researchers.**

- Target: Establish at least ten new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Centers, and find opportunities for space experiments. 1H22

**Objective: Foster commercial participation on the International Space Station.**

- Target: Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes. 1H23

### **Goal: Share the Experience and Discovery of human space flight**

**Objective: Increase the scientific, technological and academic achievement of the nation by sharing our knowledge, capabilities, and assets.**

- Target: Support participation in HEDS research. In 2001 HEDS will enable at least 50 students to participate in commercial space flight and technologies research and provide 200 elementary and high school classrooms nationwide with electronic (multimedia/computer technologies) and printed materials that focus on activities in science, math and technology relating to life sciences and microgravity research and specifically written for students in grades K-12. In addition HEDS will complete a broadly based student competition on innovative design concepts that address HEDS technological challenges and complete a customer engagement plan. 1H26

### **Cross-cutting target**

- Target: Improve health of the NASA workforce. HEDS will develop and implement supervisor-specific training for the identification and management of stress in the work unit. Develop and implement training on techniques for coping with stress for the individual employee and begin a robust audit program of NASA Centers' occupational health programs, completing at least six (6) to ensure quality and continuous improvement of medical care and services including medical and environmental monitoring efforts, preventive services, emergency response capability, and clinical intervention capability. 1H29

## **Internal Assessment**

Interim evaluation and monitoring of performance targets will be conducted as an element of regular meetings of the Office of Space Flight and HEDS Management Boards and the Board of Directors of the Office of Life and Microgravity Sciences and Applications. As a matter of NASA policy, relevant HEDS performance targets are included in the performance plans submitted to the Administrator by the Associate Administrator of the Office of Life and Microgravity Sciences and Applications, and the Associate Administrator of the Office of Space Flight.

Final data collection, reporting and verification for inclusion in the Annual Performance Report will rely on several different processes depending on the particular Performance Target. Wherever possible, a specific tangible product has been identified for individual performance targets to strengthen the validation process.

For many HEDS performance targets, (e.g. Space Shuttle in-flight anomalies, Space Station assembly milestones) verification of performance is straightforward and progress is monitored through regular management channels and reports. For targets which include references, investigators and/or peer reviewed publications, HEDS publishes, and makes available on line, an annual "Task Book and Bibliography" which includes lists of investigators, publications and research results. This database will be an essential source of data for evaluating performance against several targets.

## **External Assessment**

To assist in evaluating those performance goals which are more difficult to associate with specific tangible products, HEDS will employ an annual external assessment process. HEDS has asked the Life and Microgravity Sciences and Applications subcommittee of the NASA Advisory Committee to review and evaluate performance on specific OLMSA targets on an annual basis. An OSF Advisory Committee currently being formed will review and evaluate OSF performance targets.

## Human Exploration and Development of Space FY01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	O1#	FY 01 Target	FY 01 Indicators
Goal: Expand the Space Frontier.	Objective: Expand human exploration through collaborative robotic missions	1H1	Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 orbiter and lander missions.	Complete testing and delivery for spacecraft integration for the radiation monitoring experiment hardware (MARIE). Complete testing and delivery for spacecraft integration for the soil and dust analysis experiment (MECA). Complete testing and delivery for spacecraft integration for the Mars In-Situ Propellant Production Precursor experiment (MIP) .
Goal: Expand the Space Frontier.	Objective: Define innovative human exploration mission approaches	1H2	Complete initial next decade planning mission architecture studies.	Complete initial next decade planning mission architecture studies.
Goal: Expand the Space Frontier.	Invest in enabling high-leverage technologies	1H32	Initiate the HEDS Technology/Commercialization program and establish a synergistic relationship with industry.	Indicator is a successful response to the initial NASA Research Announcement, with a 50% cost share from industry, where appropriate.
Goal: Expand Scientific Knowledge.	Objective - In partnership with the scientific community, use the space environment to investigate chemical, biological and physical systems.	1H3	Support an expanded, productive research community to include 975 investigations by 2001.	Expand support to approximately 975 investigations (from 877 reported in FY 99). Publish abstracts and reports of progress for over 90% of FY 2000 research investigations (tasks) and make this publication available on the internet. Support publication of approximately 1500 journal articles in refereed journals. Support emergent microgravity research programs in biophysics and tissue engineering by selecting up to 10 new investigations.
Goal: Expand Scientific Knowledge.	Objective - In partnership with the scientific community, use the space environment to investigate chemical, biological and physical systems.	1H4	Conduct outstanding peer-reviewed and commercial research on STS 107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion.	Acquire unique data to improve crew health and safety and expand understanding in biology, biotechnology cell science, fluid physics, and combustion science.
Goal: Expand Scientific Knowledge.	Objective - In partnership with the scientific community, use the space environment to investigate chemical, biological and physical systems.	1H5	Begin research on the International Space Station.	Increase fundamental knowledge in biological and biomedical sciences and address critical questions in crew health and safety by conducting 6 to 10 ISS investigations. Acquire unique data on colloidal self-assembly as an essential first step in the synthesis of new materials from colloidal particles. Measure the ISS acceleration environment, develop models to characterize the effects of that environment on ISS research, and disseminate those results to the ISS investigator community.

## Human Exploration and Development of Space FY01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	01#	FY 01 Target	FY 01 Indicators
Enable and establish a permanent and productive human presence in Earth orbit.	Provide safe and affordable access to space.	1H6	The Office of Space Flight will expedite a safety improvement program to ensure the continued safe operations of the Space Shuttle that ensures the availability of a safe and reliable Shuttle system to support Space Station Assembly milestones and operations.	CLCS application for the Orbiter Processing Facilities is completed.
Enable and establish a permanent and productive human presence in Earth orbit.	Provide safe and affordable access to space.	1H7	Achieve 8 or fewer flight anomalies per mission.	Achieve 8 or fewer flight anomalies per mission.
Enable and establish a permanent and productive human presence in Earth orbit.	Provide safe and affordable access to space.	1H30	Achieve 100% on-orbit mission success.	Pre-flight mission/payload objective. Post-flight mission report.
Enable and establish a permanent and productive human presence in Earth orbit	Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives	1H10	Successfully complete the majority of the planned development schedules and milestones required to support the Multi-element Integration Testing.	Complete Multi-Element Integration Test II (MEIT) to include flight elements for assembly flights 8A through 12A. This will be measured by completion of five-planned test configurations. MEIT Tests perform integration testing with several launch elements to increase on-orbit confidence.
Enable and establish a permanent and productive human presence in Earth orbit	Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives	1H11	Successfully complete the majority of the ISS planned on-orbit activities such as delivery of mass to orbit and enhanced functionality.	Continue to expand the capabilities of the ISS through launch and delivery of 180,000 lbs. of hardware and logistics to the ISS.  Initiate and demonstrate station-based Extravehicular Activity (EVA) capability to support up to 30 EVAs annually from the U.S. Airlock. This will be measured by completion of a minimum of 5 EVAs from the ISS Airlock.
Enable and establish a permanent and productive human presence in Earth orbit	Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives	1H12	Successfully complete the majority of combined ISS planned operations schedules and milestones as represented by permanent human on-orbit operations.	Conduct permanent human on-orbit operations with an estimated 8,000 crew hours dedicated to assembly, vehicle operations and payload operations.
Enable and establish a permanent and productive human presence in Earth orbit	Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives	1H13	Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities.	Initiate on-orbit research in the U.S. Laboratory focusing on early payload opportunities in the Human Research Facility (HRF-1) and four multipurpose EXPRESS Racks.  Complete integration testing and KSC processing for the Microgravity Sciences Glovebox (MSG), refrigerator/freezer, and Window Observational Research Facility (WORF-1) in preparation for launch on UF-1 and UF-2. This will be measured by completion of schedule milestones.

## Human Exploration and Development of Space FY01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	O1#	FY 01 Target	FY 01 Indicators
Enable and establish a permanent and productive human presence in Earth orbit	<p>Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives</p> <p>Ensure and enhance the health, safety, &amp; performance of humans in space</p>	1H14	Successfully complete no less than 85% of the planned Russian Program Assurance schedules and milestones required for the development of the Propulsion Module.	Initiate Propulsion Module Fabrication/Assembly/Integration and Testing in preparation for launch in late FY 2002. This will be measured by completion of schedule milestones.
Enable and establish a permanent and productive human presence in Earth orbit	<p>Deploy and use the ISS to advance scientific, exploration, engineering, and commercial objectives</p> <p>Ensure and enhance the health, safety, &amp; performance of humans in space</p>	1H15	Successfully complete no less than 75% of the planned crew return capability schedules. FY01 indicators will include accomplishment of program schedule milestones for Phase 1 development of a crew return vehicle that could provide U.S. crew return capability.	Complete Crew Return Vehicle (CRV) Phase 1 tasks including Preliminary Design Review (PDR). This will be measured by completion of schedule milestones.
Enable and establish a permanent and productive human presence in Earth orbit	Objective: Ensure the health, safety and performance of humans living and working in space	1H17	Develop new biomedical and technological capabilities to facilitate living and working in space and the safe return to Earth.	Flight test countermeasure to reduce kidney stone risk . Develop two new evidence-based health protective countermeasure candidates ready for evaluation in an operational setting.
Enable and establish a permanent and productive human presence in Earth orbit	Objective: Ensure the health, safety and performance of humans living and working in space	1H18	Develop and demonstrate technologies for improved life support systems.	Demonstrate, in ground test, technologies that could reduce up to 25% of life support logistics over ISS baseline and release report of progress for review on the internet. Perform detailed calculation of life support equivalent system mass index and place online for review and comment. Equivalent system mass index is a measure of the performance of a life support system incorporating demonstrated technologies.
Enable and establish a permanent and productive human presence in Earth orbit	Objective: Ensure the health, safety and performance of humans living and working in space	1H31	Initiate implementation of the Bioastronautics Initiative.	Initiate NASA/NCI collaboration to develop minimally invasive technologies and approaches for detecting and interpreting biological signatures that signal the emergence of disease. Initiate expansion of the teams and tasks of the NSBRI for the development of countermeasures, by adding approximately 15 investigations (tasks).



## Human Exploration and Development of Space FY01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	01#	FY 01 Target	FY 01 Indicators
Enable and establish a permanent and productive human presence in Earth orbit.	Meet sustained space operations needs while reducing costs.	1H20	Increase the percentage of the space operations budget allocated to acquisition of communications and data services from the commercial sector to 15%.	Increase to 15% the space operations budget allocated to acquisition of commercial communications and data services from the 10% FY 2000 performance target.
Enable and establish a permanent and productive human presence in Earth orbit.	Meet sustained space operations needs while reducing costs.	1H21	Achieve at least 95 percent of planned data delivery, on average, from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operations requirements in project service level agreements.	Achieve at least 95 percent data delivery for all space flight missions as documented in network performance metrics.
Goal: Expand the Commercial Development of Space.	Facilitate access to space for commercial researchers	1H22	Establish at least ten new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Centers and find opportunities for space experiments.	Ensure that Commercial Centers execute ten new partnership agreements. Monitor the ratio of flight experiments to ground experiments.
Goal: Expand the Commercial Development of Space.	Foster commercial participation on the International Space Station.	1H23	Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes.	Review and/or implementing Space Station resource pricing and intellectual property rights policies. Ensure Space Station resources allocated to commercial research are utilized by commercial partners to research tomorrow's products and improve industrial processes.
Goal: Share the Experience and Discovery of human space flight	Increase the scientific, technological and academic achievement of the nation by sharing our knowledge, capabilities, and assets	1H26	Support participation in HEDS research.	Enable at least 50 students to participate in commercial space flight and technologies research. Through the use of national teacher conferences and workshops, provide approximately 200 elementary and high school classrooms nationwide with electronic (multimedia/computer technologies) and printed materials that focus on activities in science, math and technology relating to life sciences and microgravity research and specifically written for students in grades K-12. Complete a broadly based student competition on innovative design concepts that address HEDS technological challenges. Complete customer engagement plan.
Cross-cutting target		1H29	Improve health of the NASA workforce	Develop and implement supervisor-specific training for the identification and management of stress in the work unit. Develop and implement training on techniques for coping with stress for the individual employee. Begin a robust audit program of NASA Centers' occupational health programs, completing at least six (6) to ensure quality and continuous improvement of medical care and services including medical and environmental monitoring efforts, preventive services, emergency response capability, and clinical intervention capability.

<b>HEDS FY01</b>	<b>Budget Category</b>	<b>Space Station</b>	<b>Space Shuttle</b>	<b>Payload and ELV Support</b>	<b>Space Operations</b>	<b>Life and Microgravity Sciences</b>	<b>HEDS Investments</b>	<b>Research and Program Management</b>
<b>Performance Target</b>								
1H1: Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 orbiter and lander missions.						<b>X</b>	<b>X</b>	
1H2: Complete initial next decade planning mission architecture studies.							<b>X</b>	
1H32: Initiate the HEDS Technology/Commercialization program and establish a synergistic relationship with industry.							<b>X</b>	
1H3: Support an expanded, productive research community to include 975 investigations by 2001.						<b>X</b>		
1H4: Conduct outstanding peer-reviewed and commercial research on STS 107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion.						<b>X</b>		
1H5: Begin research on the International Space Station						<b>X</b>		
1H6: The Office of Space Flight will expedite a safety improvement program to ensure the continued safe operations of the Space Shuttle that ensures the availability of a safe and reliable Shuttle system to support Space Station Assembly milestones and operations.			<b>X</b>					
1H7: Achieve 8 or fewer flight anomalies per mission.			<b>X</b>					
1H30: Achieve 100% on-orbit mission success			<b>X</b>					
1H10: Successfully complete the majority of the planned development schedules and milestones required to support the Multi-element Integration Testing		<b>X</b>						
1H11: Successfully complete the majority of the ISS planned on-orbit activities such as delivery of mass to orbit and enhanced functionality.		<b>X</b>						

<b>HEDS FY01</b>	<b>Budget Category</b>	<b>Space Station</b>	<b>Space Shuttle</b>	<b>Payload and ELV Support</b>	<b>Space Operations</b>	<b>Life and Microgravity Sciences</b>	<b>HEDS Investments</b>	<b>Research and Program Management</b>
<b>Performance Target</b>								
1H12: Successfully complete the majority of combined ISS planned operations schedules and milestones as represented by indicators of permanent human on-orbit operations.		<b>X</b>						
1H13: Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities.		<b>X</b>				<b>X</b>		
1H14: Successfully complete no less than 85% of the planned Russian Program Assurance schedules and milestones required for the development of the Propulsion Module.		<b>X</b>						
1H15: Successfully complete no less than 75% of the planned crew return capability schedules. FY01 indicators will include accomplishment of program schedule milestones for Phase 1 development of a crew return vehicle that could provide U.S. crew return capability.		<b>X</b>						
1H17: Develop new biomedical and technological capabilities to facilitate living and working in space and safe return to Earth.						<b>X</b>		
1H18: Develop and demonstrate technologies for improved life support systems.						<b>X</b>		
1H31: Initiate implementation of the Bioastronautics Initiative						<b>X</b>		
1H20: Increase the percentage of the space operations budget allocated to acquisition of communications and data services from the commercial sector to 15%.					<b>X</b>			

<b>HEDS FY01</b>	<b>Budget Category</b>	Space Station	Space Shuttle	Payload and ELV Support	Space Operations	Life and Microgravity Sciences	HEDS Investments	Research and Program Management
<b>Performance Target</b>								
1H21: Achieve at least 95 per cent of planned data delivery, on average, from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operations requirements in project service level agreements.					<b>X</b>			
1H22: Establish at least ten new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Centers, and find opportunities for space experiments						<b>X</b>		
1H23 Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes.		<b>X</b>				<b>X</b>		
1H26: Support participation in HEDS research.						<b>X</b>		
1H29: Improve health of the NASA workforce						<b>X</b>		

## Aero-Space Technology Enterprise

### Mission

The Aero-Space Technology (AST) Enterprise mission is to pioneer the identification, development, verification, transfer, application, and commercialization of high-payoff aerospace technologies. Research and development programs conducted by the Enterprise contribute to national security, economic growth, and the competitiveness of American aerospace companies. The Enterprise plays a key role in maintaining a safe and efficient national aviation system and enabling an affordable, reliable space transportation system. The Enterprise directly supports national policy in both aeronautics and space as directed in the President's Goals for a National Partnership in Aeronautics and Research Technology, the National Space Policy, and the National Space Transportation Policy.

### Implementation Strategy

The Enterprise manages a clearly defined portfolio of technology investments to ensure alignment with national policy, Agency goals, customer requirements, and budget availability. The investment strategies are focused on issues associated with future aviation and space systems. Enterprise objectives are outcome-focused and "stretch" beyond our current knowledge base. The outcome-focused nature of the objectives projects a preferred end-state within the air and space transportation systems. Designated Lead Centers have been assigned the responsibility to manage the implementation and execution phases of the technology programs. Enterprise programs are often conducted in cooperation with other Federal agencies, primarily the Federal Aviation Administration and the Department of Defense. These partnerships take advantage of the national investment in aeronautics and astronautics capabilities and eliminate unnecessary duplication.

The Enterprise supports the maturation of technology to a level such that it can be confidently integrated into current and new systems. In most cases, technologies developed by the Enterprise can be directly transferred to the external customer.

### Enterprise Resource Requirements

The President has requested the following budget for FY 1999 to FY 2005 to support the accomplishment of AST goals:

	<b><u>FY 1999</u></b>	<b><u>FY 2000</u></b>	<b><u>FY 2001</u></b>	<b><u>FY 2002</u></b>	<b><u>FY 2003</u></b>	<b><u>FY 2004</u></b>	<b><u>FY 2005</u></b>
NOA \$M	1,339	1,125	1,193	1,549	1,949	2,245	2,303
CS FTE	4,227	4,227	4,414	4,463	4,576	4,564	4,537

### Performance Measures

The following Targets have been established in support of the Enterprise's Strategic Goals and accompanying Objectives; the noted time horizons of 10, 15 and 25 years for these objectives correspond to 2007, 2012 and 2022, respectively:

**Global Civil Aviation Goal — Develop an environmentally friendly global air transportation system for the next century of unquestioned safety that improves the Nation's mobility.**

**Objective - Reduce the aircraft accident rate by a factor of 5 within 10 years and by a factor of 10 within 25 years. (the reference baseline is Federal Aviation accident statistics for 1993 through 1996).**

- Complete 75% of the conceptual designs of systems for preventing and mitigating accidents (programmatic performance indicators in appendix), and demonstrate tools for accident analysis and risk assessment; indicators include information data base and tool development, system architecture definition and evaluation, as well as ground and flight tests. (Target 1R1)

**Objective - Reduce Emissions of future aircraft by a factor of three in 10 years and by a factor of five within 25 years. (the reference baseline is International Civil Aviation Organization 1996 emissions standards).**

- Complete one system level technology benefit assessment, one component concept selection and one new material system; indicators include a technology benefit assessment, advanced concepts definition and selection, development of advanced materials and design methods. (Target 1R2)

**Objective – Reduce perceived noise levels of future aircraft by a factor of two in 10 years, and by a factor of four in 25 years. (the reference baseline is representative 1997 production aircraft).**

- Complete large-scale demonstration of a 2-5 decibel reduction in aircraft noise based on 1997 production technology, and initial assessments of concepts offering additional reduction; indicators are results of large scale component ground tests and analytical noise predictions, respectively. (Target 1R3)

**Objective – While maintaining safety, triple the aviation system throughput in all weather conditions within 10 years (the reference baseline is 1997 operational data from the nation's top 64 airports).**

- Complete the civil tiltrotor project by validating databases for contingency power, flight paths, and noise reduction, as well as complete at least one demonstration of an airspace management decision support tool; indicators include demonstrations of decision support and communication tools, as well as design databases. (Target 1R4)

## **Revolutionary Technology Leaps Goal – Revolutionize air travel and the way in which air and space vehicles are designed, built, and operated.**

**Objective – Invigorate the general aviation industry, so it can deliver 10,000 aircraft annually within 10 years, and 20,000 aircraft annually within 25 years.**

- Complete the Advanced General Aviation Transport Experiments project by validating transportation system concepts through flight test and publish design guidelines; indicators include simulations and flight tests, and published design guidelines and standards. Also establish at least one partnership agreement on Small Aircraft Transportation System program. (Target 1R7)

**Objective – Provide next generation design tools to increase design confidence, and cut the development cycle time for aircraft in half within 10 years (the reference baseline is representative 1997 industry timeframes).**

- Develop at least three new design tools and accomplish at least four demonstrations of advances in computation and communications; indicators include computer testbed demonstrations, real-time remote access of data, and new design methods. (Target 1R8)

**Objective – Provide next generation experimental aircraft to increase design confidence, and cut the development cycle time for aircraft in half within 10 years.**

- Demonstrate two new concepts in flight and identify five new concepts for further examination; indicators include vehicle development, flight tests and systems analyses of advanced concepts. (Target 1R9)

## **Space Transportation Goal – Achieve the full potential of space for all human endeavor through affordable space transportation**

**Objective – Reduce the payload cost to low-Earth orbit by an order of magnitude, from \$10,000 to \$1,000 per pound, within 10 years, and by an additional order of magnitude within 25 years.**

- Complete assembly of the third X-34 test vehicle, demonstrate 75% of supporting technology developments (programmatic performance indicators in appendix), and complete competitive solicitations for expanded 2nd generation reusable launch vehicle efforts; indicators for supporting technology development include both flight tests and ground tests. (Target 1R10)

**Objective – Reduce the cost of interorbital transfer by an order of magnitude and travel time for planetary missions by a factor of two within 15 years (the reference baseline is representative 1997 systems).**

- Commence X-37 vehicle assembly, and complete one Pathfinder flight experiment. (Target 1R11)

## **Research and Development Services Goal – Enable, and as appropriate provide, on a national basis, world-class aerospace R&D services, including facilities and expertise**

**Objective – Provide world-class aerospace research and development services, facilities and expertise.**

- Continue the solicitation of customer feedback on the services, facilities and expertise provided by the Aero-Space Technology Enterprise; indicators include two customer survey instruments utilized by the Aero-Space Technology Enterprise, along with documented cases of new technologies transferred to industry and other government agencies. (Target 1R12)
- Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 01; indicators include examples of educational outreach activities for current plans and the planning documentation for new programs. (Target 1R13)

## **Internal Assessment**

The Aero-Space Technology Enterprise regularly reviews its progress on achieving its performance targets using NASA's established policies and procedures for program and project management. Evaluation is provided by the governing Program Management Council, either at the Agency-level or at the designated Lead Center, which meet at least quarterly to execute their oversight responsibilities. The AST Enterprise also relies on the extensive Safety, Quality, and Reliability processes and Center organizations to assure that performance in our facilities is maintained to standards appropriate for research and technology development operations.

## **External Assessment**

The Aero-Space Technology Committee of the NASA Advisory Council will conduct annual assessments of the progress made by the OAT Enterprise in achieving its near-term technology objectives. This committee, and its nine technical subcommittees consisting of nearly 150 members from other government agencies, industry and academia that meet two to three times a year, will provide a qualitative progress measurement (Green, Yellow, or Red). "Green" will indicate that the objective was met; "Yellow" will indicate a concern that an objective was not fully accomplished; and "Red" will indicate that events occurred that prevented or severely impaired the accomplishment of the objective. The assessment will include commentary to clarify and supplement the qualitative measures.



## Aero-Space Technology Enterprise FY 01 Performance Plan

Strategic Plan Goal	Strategic Plan Objective	01#	FY 01 Targets	FY 01 Indicator Characterization
Global Civil Aviation	Reduce the aircraft accident rate by a factor of 5 within 10 years and by a factor of 10 within 25 years.	1R1	NASA's research stresses aviation system monitoring and modeling, accident prevention and accident mitigation. The performance target is to complete 75% of the conceptual designs of systems for preventing and mitigating accidents (programmatic performance indicators in appendix), and to demonstrate tools for accident analysis and risk assessment.	FY 01 indicators include information data base and tool development, system architecture definition and evaluation, as well as ground and flight tests.
Global Civil Aviation	Reduce Emissions of future aircraft by a factor of two in 10 years, and by a factor of five in 25 years.	1R2	NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen and carbon dioxide. The performance target is to complete one system-level technology benefit assessment, one component concept selection and one new material system.	FY 01 indicators include a technology benefit assessment, advanced concepts definition and selection, development of advanced materials and design methods.
Global Civil Aviation	Reduce perceived noise levels of future aircraft by a factor of two in 10 years, and by a factor of four in 25 years.	1R3	NASA's research has stressed reducing noise in the areas of engines, nacelles, engine/airframe integration, aircraft interiors and flight procedures. The performance target is complete large-scale demonstration of a 2-5-decibel reduction in aircraft noise based on 1997 production technology, and initial assessments of concepts offering an additional 3-decibel reduction.	FY 01 indicators are results of large-scale component ground tests.
Global Civil Aviation	While maintaining safety, triple the aviation system throughput in all weather conditions within 10 years	1R4	NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The performance target is to complete the civil tiltrotor project by validating databases for contingency power, flight paths, and noise reduction, as well as complete at least one demonstration of an airspace management decision support tool.	FY 01 indicators include demonstrations of decision support and communication tools, as well as design databases.

## Aero-Space Technology Enterprise FY 01 Performance Plan

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>01#</b>	<b>FY 01 Targets</b>	<b>FY 01 Indicator Characterization</b>
Revolutionary Technology Leaps	Invigorate the general aviation industry, so it can deliver 10,000 aircraft annually within 10 years, and 20,000 aircraft annually within 25 years.	1R7	NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high-productivity utilization of existing runways. The performance target is to complete the Advanced General Aviation Transport Experiments project by validating transportation system concepts through flight test and publish design guidelines, and to also establish at least one partnership agreement on Small Aircraft Transportation System program.	FY 01 indicators include simulations and flight tests, publishing of design guidelines and standards, signing of new partnership agreements.
Revolutionary Technology Leaps	Provide next-generation design tools to increase design confidence, and cut the development cycle time for aircraft in half in 10 years.	1R8	NASA's research stresses high-speed computing, high-capacity networks, and improved physics-based methods. The performance target is to develop at least three new design tools and accomplish at least four demonstrations of advances in computation and communications.	FY 01 indicators include computer testbed demonstrations, real-time remote access of data, and new design methods.
Revolutionary Technology Leaps	Provide next-generation experimental aircraft to increase design confidence, and cut the development cycle time for aircraft in half in 10 years	1R9	NASA's research stresses affordable flight demonstrations of revolutionary vehicle concepts (low-cost X-Planes) to accelerate technology advances in laboratory research, new design tools and advanced simulation. The performance target is to demonstrate two new concepts in flight and identify five new concepts for further examination.	FY 01 indicators include vehicle development, flight tests and systems analyses of advanced concepts.
Space Transportation	Reduce the payload cost to low-Earth orbit by an order of magnitude (from \$10,000 to \$1,000 per pound) within 10 years, and by an additional order of magnitude within 25 years.	1R10	NASA's research stresses highly reliable, fully reusable configurations, advanced materials and innovative structures. The performance target is to complete assembly of the third X-34 test vehicle, and demonstrate 75% of the technology developments (programmatic performance indicators in appendix) for reusable launch vehicles.	FY 01 indicators include vehicle development, flight tests and ground tests of advanced technologies.

## Aero-Space Technology Enterprise FY 01 Performance Plan

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>01#</b>	<b>FY 01 Targets</b>	<b>FY 01 Indicator Characterization</b>
Space Transportation	Reduce the cost of interorbital transfer by an order of magnitude and travel time for planetary missions by a factor of two within 15 years.	1R11	NASA's research stresses technology for reusable, long-life, high-power electric and advanced, clean chemical engines for Earth orbital transfer and breakthrough propulsion, precision landing systems and aerocapture systems for planetary exploration. The performance target is to commence X-37 vehicle assembly, and complete one Pathfinder flight experiment.	FY 01 indicators include flight vehicle development progress and conduct of flight experiments.
Research & Development (R&D)	Provide world-class aerospace research and development services, facilities and expertise	1R12	Continue the solicitation of customer feedback on the services, facilities and expertise provided by the Aero-Space Technology Enterprise	FY 01 indicators include two customer survey instruments utilized by the Aero-Space Technology Enterprise, along with documented cases of new technologies transferred to industry and other government agencies.
Research & Development (R&D)	Provide world-class aerospace research and development services, facilities and expertise	1R13	Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 01.	FY 01 indicators include examples of educational outreach activities for current plans and the planning documentation for new programs.

AST FY01	AERO-SPACE FOCUSED											AERO-SPACE BASE R&T								
	Budget Category	Aviation System Capacity	Aviation Safety Technology	High Performance Comput'g & Comm.	Ultra Efficient Engine Technology	Small Aircraft Transportation System	Quiet Aircraft Technology	X-33	X-34	Future-X	2nd Generation RLV	Operations Systems	Flight Research	Information Technology	Propulsion & Power	Rotorcraft	Vehicle Systems Technology	Space Transfer & Launch Technology	Commercial Technology	R&PM
Performance Target																				
Aviation Safety (1R1)			X									X		X	X	X	X			X
Environmental Compatibility - Emissions (1R2)					X								X		X					X
Environmental Compatibility - Noise (1R3)							X										X			X
Affordable Air Travel - Throughput (1R4)		X											X	X						X
General Aviation Revitalization (1R7)						X									X		X			X
Next-Generation Design Tools (1R8)				X										X		X	X			X
Next-Generation Experimental Aircraft (1R9)													X		X		X			X
Space Access (1R10)								X	X	X	X			X	X		X	X		X
In-Space Transportation (1R11)										X	X							X		X
R&D Services - Customer Feedback (1R12)																				X
R&D Services - Education Outreach (1R13)																				X

## Manage Strategically

### Goal

The goal of this process is to ensure that the Agency carries out its responsibilities effectively and safely and that management makes critical decisions regarding implementation activities and resource allocations that support NASA's strategic, implementation, and performance plans.

For FY 2001 NASA's strategic management performance objectives (and associated performance targets) require the Agency to make the most effective use of appropriated funds, workforce, procurement processes, and information technologies.

### Performance Measures

**Goal: Ensure that the Agency meets its responsibilities safely and effectively, as it allocates its resources to support NASA's strategic, implementation, and performance Plans.**

In order to know how successful we are in meeting the Manage Strategically goals and objectives, we have established four performance targets against which we will measure our progress.

**Objective: Assess, document, communicate and mitigate the programmatic and technical risks associated with NASA programs and projects; focus special attention toward addressing and mitigating safety and health risks presented by our work environment and our projects.**

As a part of assessing, documenting and mitigating the programmatic and technical risks associated with our programs, our performance target will be to:

- Target: Increase the safety of NASA's infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees. 1MS1
- One of the indicators used to evaluate our performance is whether we can reduce by 3% per year from the FY 97 baseline the overall occurrence of injuries (due to occupational injury or illness) to 1.15 occurrences per 100 workers. This indicator also measures compliance with the Administration's Federal Worker 2000 Presidential Initiative.
- In order to evaluate the effectiveness and efficiency of Agency acquisitions our performance targets will be to:

**Objective: Improve the effectiveness and efficiency of Agency acquisitions through the increased use of techniques and management that enhance contractor innovation and performance.**

- Target: Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs), and maintain significant contractor involvement in NASA programs for small businesses, minority institutions, and minority and women owned businesses. 1MS2
- The percentage of awards to small and disadvantaged businesses and the obligation of at least 80% of the funds available for PBCs are two of the indicators that will be used to evaluate our performance against this target.

**Objective: Optimize Agency investment strategies and systems to align human, physical, and financial resources with customer requirements, while ensuring compliance with applicable statutes and regulations.**

The optimal use of Agency investments and systems to meet customer requirements will be evaluated against the performance target to:

- Target: Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training. 1MS3

Among the indicators of progress, we will monitor the utilization of technology based learning, striving for a 10% increase over our usage in FY 2000.

**Objective: Ensure that information technology provides an open and secure exchange of information, is consistent with Agency technical architectures and standards, demonstrates a projected return on investment, reduces risk, and directly contributes to mission success.**

Our final performance target has been established to monitor our progress in ensuring that information technology provides an open and secure exchange of information while meeting technical and architectural standards and demonstrating a projected return on investments. Our performance target will be to:

- Target: Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory", and enhance IT security through a reduction of system vulnerabilities across all NASA centers, emphasizing IT security awareness training for all NASA personnel. 1MS4

The indicators used to measure our service delivery include measurement of system capacity and the cost of units of capacity.

The Appendix contains a complete list of Manage Strategically indicators for FY 01.

## MS FY01 Performance Plan

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>01 #</b>	<b>FY01 Targets</b>	<b>FY01 Indicators</b>
Ensure that the Agency meets its responsibilities safely and effectively, as it allocates its resources to support NASA's strategic, implementation, and performance plans.	Assess, document, communicate, and mitigate the programmatic and technical risks associated with NASA programs and projects; focus special attention toward addressing and mitigating safety and health risks presented by our work environment and our projects.	1MS1	NASA will increase the safety of its infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees.	Examples of our indicators of progress toward our safety target include the award/modification of contracts for physical security upgrades to NASA's Minimum Essential Infrastructure (1MS1b), and achieving a lost-time employee injuries per 200,000 hours worked rate of 0.20 or less.
	Improve the effectiveness and efficiency of Agency acquisitions through the increased use of techniques and management that enhance contractor innovation and performance.	1MS2	Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBC's), and maintain significant contractor involvement in NASA programs of small businesses, minority institutions, and minority and women owned businesses.	Examples of our indicators are maintaining PBC obligations to 80% of funds available for PBC's (excluding grants, cooperative agreements, actions under \$100,000, SBIR, STTR, FFRDC's, intragovernmental agreements, and contracts with foreign governments or international organizations), and achieving at least an 8% goal for annual funding to small disadvantaged businesses.
	Optimize Agency investment strategies and systems to align human, physical, and financial resources with customer requirements, while ensuring compliance with applicable statutes and regulations.	1MS3	Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training.	Examples of our indicators will be costing at least 75% of the resources authority available to cost during the fiscal year, increasing training opportunities in technology-based learning by 10%, and increasing by 20% employee use of technology-based learning opportunities
	Ensure that information technology provides an open and secure exchange of information, is consistent with Agency technical architectures and standards, demonstrates a projected return on investment, reduces risk, and directly contributes to mission success.	1MS4	Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory," and enhance IT security through reduction of system vulnerabilities across all NASA centers, emphasizing IT security awareness training for all NASA personnel.	Indicators include measurement system capacity, cost of units of capacity, and customer satisfaction rating of service provided.

<b>Manage Strategically FY01</b>	<b>Budget Category</b>	<b>Space Science</b>	<b>Earth Science</b>	<b>HEDS</b>	<b>Aero-Space Technology</b>	<b>Research &amp; Program Management</b>				
<b>Performance Target</b>										
NASA will increase the safety of its infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees. (1MS1)		X	X	X	X	X				
Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBC's), and maintain significant contractor involvement in NASA programs of small businesses, minority institutions, and minority and women owned businesses. (1MS2)		X	X	X	X	X				
Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training. (1MS3)		X	X	X	X	X				
Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 98 baseline; and enhance IT Security through reduction of system vulnerabilities across all NASA Centers and through emphasis on IT security awareness training for all NASA personnel. (1MS4)		X	X	X	X	X				



## **Provide Aerospace Products and Capabilities**

### **Goals**

This process is the means by which NASA's Strategic Enterprises and their Centers deliver systems (ground, aeronautics, space), technologies, data, and operational services to NASA customers. Through the use of Agency facilities, customers can conduct research, explore and develop space, and improve life on Earth. This process is used to answer the Agency fundamental question: "What cutting-edge technologies, processes, techniques, and engineering capabilities must we develop to implement our research agenda in the most productive, economical, and timely manner?" The goal of the process is to enable NASA's Strategic Enterprises and their Centers to deliver products and services to customers more effectively and efficiently. The process is also used to enable the Communicate Knowledge process to extend the technology, research, and science benefits from NASA programs broadly to the public and commercial sectors.

### **Performance Measures**

**Goal: Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors**

#### **Objective - Meet schedule and cost commitments**

NASA's role in the advancement of research and technology is conducted through the construction and operation of facilities such as telescopes, satellites, and ground-based laboratories and test facilities.

The performance target will be to:

- Keep the development and upgrade of major scientific facilities and capital assets within budget. On average, the Agency will not exceed 110 percent of cost and schedule estimates. Target 1P1

#### **Objective - Improve and maintain NASA's engineering capability**

The performance targets will be to:

- Ensure the availability of NASA's spacecraft and facilities by decreasing operating time lost to unscheduled downtime, relative to FY00 availability. Target 1P3
- Establish prototype collaborative engineering environments focused on the representative set of enterprise applications and evaluate performance against non-collaborative benchmarks. Target 1P2

**Objective - Capture and Preserve Engineering and Technological Process Knowledge to Continuously Improve NASA's P/P Management**

The performance target will be to

- Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses documented in NPG 7120.5, commensurate with current program status. These data will be implemented in PAPAC process improvement and in Program/Project Management training. Target 1P4

**Objective - Facilitate the insertion of technology into all programs and proactively transfer technology, form commercialization partnerships, and integrate all innovative approaches to strengthen U.S. competitiveness**

The performance targets will be to:

- Dedicate the percent of the technology budget that was reported in the FY00 Performance Report toward leveraging with activities of other organizations. Target 1P6
- Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. Target 1P5

**PAPAC FY01 Performance Plan**

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>01 #</b>	<b>FY01 Targets</b>	<b>FY01 Indicators</b>
<b>Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors</b>	Reduce the cost and development time to deliver products and operational services	<b>1P1</b>	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.	Development schedule and cost data are drawn from NASA budget documentation for major programs and projects to calculate the average performance measures.
<b>Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors</b>	Improve and maintain NASA's engineering capability	<b>1P2</b>	Establish prototype collaborative engineering environments focused on the representative set of enterprise applications and evaluate performance against non-collaborative benchmarks.	Evaluation of the readiness of the prototype and benchmarking of its performance will be completed.
<b>Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors</b>	Improve and maintain NASA's engineering capability	<b>1P3</b>	Ensure the availability of NASA's spacecraft and ground facilities by decreasing the operating time lost to unscheduled downtime.	Each field center is reporting the operational downtime of the facilities identified for inclusion in the measure.
<b>Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors</b>	Capture and preserve engineering and technological best practices and process knowledge to continuously improve NASA's program/project management	<b>1P4</b>	Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses documented in NPG 7120.5, commensurate with current program status. Data will be implemented in PAPAC process improvement and in Program/Project Management training.	The effectiveness of the PAPAC processes are to be evaluated via the formal collection and utilization of inputs from projects and programs.
<b>Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors</b>	Facilitate the insertion of technology into all programs and proactively transfer technology, form commercialization partnerships, and integrate all innovative approaches to strengthen U.S. competitiveness	<b>1P5</b>	Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.	Each of the Enterprises are reporting the value of their contribution to commercial partnerships.
<b>Enable NASA's Strategic Enterprises and their Centers to deliver products and services more effectively and efficiently while extending the technology, research, and science benefits broadly to the public and commercial sectors</b>	Facilitate the insertion of technology into all programs and proactively transfer technology, form commercialization partnerships, and integrate all innovative approaches to strengthen U.S. competitiveness	<b>1P6</b>	Dedicate the percentage of the technology budget that was reported in the FY00 Performance Report toward leveraging with activities of other organizations.	Each of the Enterprises reports technology development activities leveraged through formal agreements.

<b>PAPAC FY01</b>	<b>Budget Category</b>				
		HEDS	Aero-Space Technology	Space Science	Earth Science
	<b>Performance Target</b>				
	Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average. (1P1)	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
	Establish prototype collaborative engineering environments focused on the representative set of enterprise applications and evaluate performance against non-collaborative benchmarks. (1P2)		<b>X</b>		
	Ensure the availability of NASA's spacecraft and ground facilities by decreasing the operating time lost to unscheduled downtime. (1P3)	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
	Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses documented in NPG 7120.5, commensurate with current program status. Data will be implemented in PAPAC process improvement and in Program/Project Management training. (1P4)	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
	Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships. (1P5)	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
	Dedicate the percentage of the technology budget that was reported in in the FY00 Performance Report toward leveraging with activities of other organizations. (1P6)	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>

## **Generate Knowledge**

### **Goals**

NASA provides new scientific and technological knowledge gained from exploring the Earth system, the solar system, and the universe beyond, and from conducting the necessary supporting research and development. The Generate Knowledge Process ensures that this information is shared with scientists, engineers, and technologists in industry, academia, and other organizations. In addition, natural resource managers, policy-makers, and educators benefit from this process. The goals of the Generate Knowledge Process are to extend the boundaries of knowledge of science, technology, and engineering, to capture new knowledge in useful and transferable media, and to share new knowledge with customers.

The Generate Knowledge Process is conducted by NASA's three scientific research enterprises: the Space Science Enterprise (SSE); the Earth Science Enterprise (ESE); and the Office of Life and Microgravity Sciences and Applications within the Human Exploration and Development of Space Enterprise (OLMSA/HEDS).

The Generate Knowledge Process does not include research of a proprietary industrial nature or research whose conduct or dissemination is limited for reasons of national security.

As provided in the *NASA Strategic Management Handbook*, the Generate Knowledge Process is composed of eight principal sub-processes (section 6.1.2). The Generate Knowledge Strategic Objectives mirror that set of subprocesses as follows:

1. Acquire Advice,
2. Plan and Set Priorities,
3. Select and Fund/Conduct R&A Programs,
4. Select and Implement Flight Missions,
5. Analyze Data (Initial),
6. Publish and Disseminate Results,
7. Create Data Archives, and
8. Conduct Further Research.

## Performance Measures

Under the Strategic structure of a single goal and 5 objectives, NASA has defined 7 Target areas for GK for Fiscal Year 2001. Each Target has specific indicators that will provide a quantitative manner to show performance. The goal, objectives and targets are:

**Goal: Extend the boundaries of knowledge of science and engineering, to capture new knowledge in useful and transferable media, and to share new knowledge with customers.**

**Objective: Acquire advice from diverse communities.**

- Target: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will obtain scientific guidance from their investigator communities. 1G1

NASA relies on the guidance of outside customers and partners to maintain the vitality and efficacy of its research programs. This guidance is obtained through countless channels, both formal and informal. The principal vehicles for formal guidance are advisory committees chartered under the Federal Advisory Committee Act (FACA). At the conclusion of their meetings, which are conducted in conformance with the FACA statute, these committees develop and submit a letter report summarizing findings and recommendations. Each Strategic Enterprise has at least one advisory committee.

**Objective: Plan and set research priorities**

- Target: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will develop and/or release updated enterprise strategic plans. 1G2

The Strategic Enterprises operate strategic planning systems that define their goals and objectives and support agency-wide strategic management processes. Consistent with the requirements of the GPRA of 1993, the NASA strategic plan must be updated every 3 years. To support this planning cycle, each of the research offices independently updates its own Strategic Plan on a periodic basis.

**Objective: Select, fund, and conduct research programs**

- Target: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will use competitive merit review wherever possible to select performers for science and basic technology research. 1G3

For selecting, funding, and conducting both research and analysis and core technology projects, the Space Science Enterprise, OLMSA, and the Earth Science Enterprise will use broad Agency announcement (AO, NRA, and Cooperative Agreement Notice solicitations) to competitively award 80 percent or more of the resources in these programs based on peer review.

**Objective: Archive data and publish, patent, and share results**

- Target: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will disseminate results of their research to a diverse population of users, including education users and the general public. 1G4

As a recipient of public funds for public purposes, NASA disseminates the results of its research in many forms to a client base whose interests range from highly technical to public information and educational. The primary means for the dissemination of OLMSA, Space Science Enterprise, and Earth Science Enterprise scientific findings are refereed journals, papers presented at professional meetings, and popular scientific periodicals. For all NASA research areas, collaborations with universities ensure that the insertion of the technical knowledge in academia and educational outreach to K-12 audiences is being expanded.

- Target: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will make science data obtained widely accessible as soon as possible after receipt and will maintain these data in open archives. 1G5

It is NASA policy to make scientific data returned by science missions widely accessible as soon as possible after receipt and to maintain these data thereafter in openly accessible archive databases. OLMSA, the Space Science Enterprise, and the Earth Science Enterprise support a number of discipline-based archiving facilities and programs.

**Objective: Collaborate with old new partner.**

- Target: Work with other federal agencies and U.S. industry to complement and support our activities. 1G6

NASA strives to maximize the research outcomes by leveraging resources with other National agencies and the private industry. This target will establish and implement Memoranda of Understanding (MOUs) and Memoranda of Agreement (MOAs) with U.S. Federal agencies and industry for appropriate partnerships in research areas of shared interest.

- Target: Pursue mutually beneficial cooperative activities in aeronautics and space with other nations. 1G7

NASA strives to leverage resources with other space agencies with the goal of minimizing the duplication of efforts worldwide. This target will establish and implement Letters of Agreement (LOAs) and Memoranda of Understanding (MOUs) for appropriate partnerships with foreign space agencies for cooperative activities.

### Generate Knowledge FY01 Performance Plan

<b>Strategic Plan Goal</b>	<b>Strategic Plan Objective</b>	<b>01 #</b>	<b>FY01 Targets</b>	<b>FY01 Indicators</b>
<b>Extend the boundaries of knowledge of science and engineering, to capture new knowledge in useful and transferable media, and to share new knowledge with customers</b>	<b>Acquire advice from diverse communities</b>	<b>1G1</b>	The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will obtain scientific guidance from their investigator communities.	At least seven letters of advice will be received from the enterprises' FACA-chartered advisory committees.
	<b>Plan and set research priorities</b>	<b>1G2</b>	The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will develop and/or release updated enterprise strategic plans.	The Space Science Enterprise and the Earth Science Enterprise will release new enterprise strategic plans, and OLMSA/HEDS will review its new strategic plan with their advisory bodies.
	<b>Select, fund, and conduct research programs</b>	<b>1G3</b>	The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will use competitive merit review wherever possible to select performers for science and basic technology research.	Taken together, the Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will use AOs, NRAs, and Cooperative Agreement Notice solicitations to award 80 percent or more of science and basic research funds via merit competition.
	<b>Archive data and publish, patent, and share results</b>	<b>1G4</b>	The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will disseminate results of their research to a diverse population of users, including education users and the general public.	Research programs of the Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS, taken together, will account for 5 percent of the 150 "most important stories" in the annual review by <i>Science News</i> . The three enterprises will achieve their individual indicators in education and public outreach and publication of research progress. The three enterprises will maintain and periodically update publicly accessible web sites for active missions.
		<b>1G5</b>	The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will make science data obtained widely accessible as soon as possible after receipt and will maintain these data in open archives.	The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will achieve their specific individual indicators for ensuring mission data maintenance and access.
	<b>Collaborate with old and new partners</b>	<b>1G6</b>	Work with other federal agencies and U.S. industry to complement and support our activities.	Establish and implement MOUs and MOAs with U.S. Federal agencies and industry for appropriate partnerships in research areas of shared interest.
		<b>1G7</b>	Pursue mutually beneficial cooperative activities in aeronautics and space with other nations.	Establish and implement LOAs and MOUs for appropriate partnerships with foreign space agencies for cooperative activities.



<b>Generate Knowledge FY01</b>	<b>Budget Category</b>	<b>Space Science</b>	<b>Earth Science</b>	<b>HEDS</b>	<b>Aero-Space Technology</b>
<b>Performance Target</b>					
The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will obtain scientific guidance from their investigator communities. (1G1)		<b>X</b>	<b>X</b>	<b>X</b>	
The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will develop and/or release updated enterprise strategic plans.(1G2)		<b>X</b>	<b>X</b>	<b>X</b>	
The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will use competitive merit review wherever possible to select performers for science and basic technology research. (1G3)		<b>X</b>	<b>X</b>	<b>X</b>	
The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will disseminate results of their research to a diverse population of users, including education users and the general public.(1G4)		<b>X</b>	<b>X</b>	<b>X</b>	
The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will make science data obtained widely accessible as soon as possible after receipt and will maintain these data in open archives. (1G5)		<b>X</b>	<b>X</b>	<b>X</b>	
Work with other federal agencies and U.S. industry to complement and support our activities. (1G6)		<b>X</b>	<b>X</b>	<b>X</b>	
Pursue mutually beneficial cooperative activities in aeronautics and space with other nations.(1G7)		<b>X</b>	<b>X</b>	<b>X</b>	

# Communicate Knowledge

## Goals

The Communicate Knowledge (CK) process facilitates the distribution of information on NASA's missions and discoveries. It insures increased public understanding of science and technology, promotes the application of NASA-generated information, and inspires achievement and innovation. The process insures that knowledge derived from NASA research programs is available to meet the specific needs and interests of constituent groups. It begins at the inception of a research project and increases in intensity as the effort reaches maturity to insure the appropriate delivery, archiving, and future convenient access of all research results. The goal of the Communicate Knowledge Process is to insure that information derived from NASA's research efforts is distributed in a useful, timely, and reliable manner.

The Objectives described in the NASA Strategic Plan for this cross-cutting process are:

- **Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to participate directly in space research and discovery experience**
- **Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA's programs**

## Performance Measures

The Agency has defined 4 Target areas for CK for Fiscal Year 2001. Each Target has specific indicators that will provide a quantitative manner to show performance. The targets are listed below:

- Convey information about, and knowledge generated by NASA's programs, to the public Target 1CK1  
By maintaining an exhibits loan service, a fine-arts program, and by providing live satellite interviews with astronauts, program managers, and other Agency officials, NASA hopes to expose more people to the activities of the Nation's Aeronautics and Space programs. Through increased availability of documentation and digital images, the agency will provide scientists and the public greater access to NASA generated knowledge.
- Assist the public and customers to locate and retrieve information on, or that has been generated by, a NASA program. Target 1CK2  
Improve NASA's service to the public who use the Scientific Technical Information and the NASA Image Exchange Help Desks and increased utility of the NASA world wide web pages in terms of capacity and ease of locating areas of interest – based on the public's demand.
- Facilitate the transfer of NASA generated technology and innovations to private industry. Target 1CK3  
Increase the opportunities for transferring technology from NASA to private industry and the public, through the Internet using the TechTracS database and by producing a series of technology publications.
- Support educational excellence and reach out to the underserved and underrepresented minority community. Target 1CK4  
Through the exposure of students in grades kindergarten through high school, NASA expects to generate more interest in space, aeronautics, and science for the next generation of the American workforce. We will accomplish this through direct interface with

students, their teachers and the school faculty; increasing the number of sites that offer science and engineering curriculum to the underrepresented and minority students; and increasing the involvement of minority universities through sponsored research projects.

The Agency is in the process of reviewing and modifying this cross-cutting process. Any changes will be reflected in the FY02 or FY01 revised final plan.

**Communicate Knowledge FY 01 Performance Plan**

<b><u>Strategic Plan Goal</u></b>	<b><u>Strategic Plan Objective</u></b>	<b><u>FY01#</u></b>	<b><u>Targets</u></b>	<b><u>FY 01 Indicators</u></b>
Ensure that NASA's customers receive the information derived from the Agency's research and development efforts that they want, when they want it, for as long as they want it.	<ul style="list-style-type: none"> <li>Highlight existing and identify new opportunities for NASA's customers, including the public, the academic community, and the Nation's students, to participate directly in space research and discovery experience</li> </ul>	1CK1	Convey information about, and knowledge generated by NASA's programs, to the public	By maintaining an exhibits loan service, a fine-arts program, and by providing live satellite interviews with astronauts, program managers, and other Agency officials NASA hopes to expose more people to the activities of the Nation's Aeronautics and Space programs. Through increased availability of documentation and digital images, the agency will provide scientists and the public greater access to NASA generated knowledge.
		1CK2	Assist the public and customers to locate and retrieve information on, or that has been generated by, a NASA program	Improve NASA's service to the public who use the Scientific Technical Information and the NASA Image Exchange Help Desks and increased utility of the NASA world wide web pages in terms of capacity and ease of locating areas of interest – based on the public's demand.
	<ul style="list-style-type: none"> <li>Improve the external constituent communities' knowledge, understanding, and use of the results and opportunities associated with NASA's programs</li> </ul>	1CK3	Facilitate the transfer of NASA generated technology and innovations to private industry	Increase the opportunities for transferring technology from NASA to private industry and the public, through the internet using the TechTracs database and by producing a series of technology publications.
		1CK4	Support educational excellence and reach out to the underserved and underrepresented minority community	Through the exposure of students in grades kindergarten through high school, NASA expects to generate more interest in space, aeronautics, and science for the next generation of the American workforce. We will accomplish this through direct interface with students, their teachers and the school faculty; increasing the number of sites that offer science and engineering curriculum to the underrepresented and minority students; and increasing the involvement of minority universities through sponsored research projects.

<b>Communicate Knowledge - FY01</b>	<b>Budget Category</b>						
		HEDS	Aero-Space Technology	Space Science	Earth Science	Academic Programs	Research & Program Management
<b>Performance Target</b>							
Convey information about, and knowledge generated by NASA's programs, to the public (1CK1)							<b>X</b>
Assist the public and customers to locate and retrieve information on, or that has been generated by, a NASA Program (1CK2)							<b>X</b>
Facilitate the transfer of NASA generated technology and innovations to private industry (1CK3)			<b>X</b>				
Support educational excellence and reach out to the underserved and underrepresented minority community (1CK4)		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	

**APPENDIX**  
**FY 2001 PERFORMANCE PLAN**

## **Space Science Enterprise Performance Targets and Indicators**

### **Target 1S1: Successfully develop and launch no less than three of four planned missions within 10% of budget and schedule.**

Performance indicators have been identified for four missions scheduled to launch in FY01. Indicators have also been established for other missions in development.

- GALEX Development: Deliver the Galaxy Evolution Explorer (GALEX) for launch; successful launch and check-out.
- MAP Development: Deliver the Microwave Anisotropy Probe (MAP) for launch; successful launch and check-out.
- GP-B Development: Deliver GP-B for launch; successful launch and check-out.
- CATSAT Development: Deliver the Cooperative Astrophysics and Technology Satellite (CATSAT) for launch; successful launch and check-out.
- SIRTF Development: Spacecraft complete and ready for integration with Cryogenic Telescope Assembly (CTA). CTA complete and delivered to spacecraft contractor for integration with spacecraft.
- SOFIA Development: Install Protoflight 747 Cavity Door on Section 46 Cavity Mockup.
- HST Development: Install two key HST upgrades on Servicing Mission 3B: Advanced Camera for Surveys (ACS) and Solar Array 3 (SA3).
- Payload & Instrument Development – Planck: The Preliminary Breadboard Cooler Performance Report will be delivered.
- Explorer Program Future Missions: MIDEX 3&4: Throughout FY 2001, continue full-scale development of the Swift Gamma Ray Burst Explorer (Swift) and the Full-sky Astrometric Mapping Explorer (FAME). SMEX 8&9: Down-selection planned.

### **Target 1S2: Obtain expected scientific data from 80% of operating missions.**

Performance indicators have been identified for six operating missions. An indicator has also been established for another mission scheduled to launch in FY01; this indicator is to be utilized upon successful launch.

- HST Operations: Maintain an average on-target pointing efficiency of 35%, excluding the servicing mission and checkout and verification period.
- CXO Operations: Instruments meeting nominal performance expectations; complete 80% of pre-planned and commanded observations with 95% of science data recovered on ground.
- RXTE Operations: Successful operation of the Proportional Counter Array, the High Energy X-ray Timing Experiment, and the All-Sky Monitor instruments, with an average of 3 PCUs (proportional counter units) operating at 45% efficiency or higher; 90% of data recovered; ASM data posted on the web within 7 days.
- ACE Operations: Measure the composition and energy spectra of heavy nuclei in six solar energetic particle events; measure the frequency and composition of coronal mass ejection events during the year; maintain real-time solar wind data 90% of the time.
- FUSE Operations: Measure interstellar gas velocities as small as 15 km per second, make 200 independent observations on line of sight in the Milky Way and nearby Galaxies; deliver 95% of the calibrated science observations to the FUSE archive on time.

- SWAS Operations: Dedicate 6000 hours (on-source plus reference positions) to observations of galactic star forming regions, asymptotic giant branch stars, planetary nebulae, supernovae remnants, planets, and comets.
- MAP Operations: Conduct early operations, including achieving the required trajectory to L2; interrupt sky-scanning observing mode no more than 4 times per year; successfully dump data daily to DSN with transfer to GSFC.

**Target 1S3: Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs.**

Performance indicators have been drawn from technology development objectives for three missions. Indicators have also been established for achievement of mission success for astronomy rocket and balloon flights and research progress in the R&A and DA programs.

- NGST Technology Development: Inflatable Shield in Space (ISIS) technology demonstration ready to fly on Shuttle; release AO for Science Instrument; down-select to a single phase 2 prime contractor.
- FIRST Technology Development: Complete the qualification mirror (QM) fabrication.
- GLAST Technology Development: Conduct successful NAR for instrument development, project definition, and interface development.
- Sounding Rocket Flights: Achieve launch success rate of 80% for sounding rocket flights.
- Balloon Flights: Achieve launch success rate of 80% for balloon flights.
- Research and Analysis: Issue NASA Research Announcement (NRA) for Research Opportunities in Space Science (ROSS).

**Target 1S4: Successfully develop and launch no less than one of two missions within 10% of budget and schedule.**

Performance indicators have been identified for two missions scheduled to launch in FY01. Indicators have also been established for other projects in development.

- Mars '01 Orbiter Development: Deliver for launch; successful launch and check-out.
- Genesis Development: Deliver for launch; successful launch and check-out.
- Rosetta Development: Deliver the flight units for the four U.S.-provided instruments or instrument subsystems to ESA.
- TWINS Development: Continue instrument development and deliver Flight Unit #1 for Integration and Test.
- CONTOUR Development: Successful CDR, meeting all program level requirements.
- Discovery Program Future Missions: New mission selection.



**Target 1S5: Obtain expected scientific data from 80% of operating missions.**

Performance indicators have been identified for nine operating missions. Indicators have also been established for other missions scheduled to launch in FY01; these indicators are to be utilized upon successful launch.

- ISTP Operations: Continue to collect 85% of data acquired from the ISTP spacecraft and successfully execute the Wind trajectory plan.
- Cassini Operations: Complete development, test, and load Attitude and Articulation Control Subsystem flight software version A8.0; complete development, test, and load Command and Data Subsystem software version V9.0.
- Voyager Operations: Upload overlay command messages to Voyager 1 quarterly; record plasma wave data weekly (Voyager 1 and 2); return science data 10 hours per day .
- Ulysses Operations: Capture at least 90% of available Ulysses science data. These will be the only data observed from outside-of-the-ecliptic plane.
- SAMPEX Operations: Obtain at least 60% data coverage from at least three of SAMPEX's four instruments.
- FAST Operations: Simultaneously gather particle and fields data during 75% of its high altitude encounters with the northern hemisphere auroral zone and 25% of its high altitude encounters with the southern hemisphere auroral zone; successfully deliver at least 85% of these data.
- TRACE Operations: Conduct solar observing operations during all orbits where EUV images of the sun can be obtained using a 5-day-per-week/8-hour-per-day planning and operations cycle; deposit all TRACE data products into a web-based data system.
- Stardust Operations: Earth flyby for gravity assist.
- Mars Global Surveyor (MGS) Operations: Complete primary mapping mission.
- TIMED Operations: One complete season (at least 90 days) of successful data collection at the required resolution and accuracy.
- HESSI Operations: Obtain hard-X-ray images of solar flares with angular resolution approximately 2 arcseconds and energy resolution approximately 1 keV (kilo-electron volts); obtain high-resolution X-ray and gamma-ray spectra of solar flares with approximately 1 keV energy resolution to energies as high as 20 MeV (million electron volts).
- IMAGE Operations: Acquire measurements at minute time scales, returning 85% real-time coverage of the Earth's magnetospheric changes; perform routine pipeline processing of browse products and deliver to the National Space Science Data Center (NSSDC) within 72 hours.
- Genesis Operations: If launched, start operations, insert spacecraft into L-1 halo orbit and start science phase.
- Mars '01 Orbiter Operations: Successfully perform required trajectory correction maneuvers and planned instrument checkout activities.

**Target 1S6: Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs.**

Performance indicators have been drawn from technology development objectives for three missions, as well as for future mission sets and for specific multi-mission technology development efforts. Indicators have also been established for achievement of mission success for space physics rocket and balloon flights and research progress in the R&A and DA programs.

- Solar-B Technology Development: Deliver engineering model of the optical telescope and x-ray telescope.
- STEREO Technology Development: Successfully complete Phase B effort including Confirmation Review.
- Solar Probe Technology Development: Begin Solar Probe prototype thermal shield fabrication.
- Future ST Probes Technology Development: Complete preliminary concept definitions for spacecraft systems and instruments for Magnetospheric Multiscale.
- Future Deep Space Technology Development: Deliver X-2003 Level 1-3 Requirements Documents; define subsystem interfaces; demonstrate intermediate-level multi-functional structures (MFS); complete definition of system architecture; evaluate key risk areas and pass decision gates.
- CISM Technology Development: Demonstrate and deliver prototype advanced power transistor [0.35 micron SOI (Silicon On Insulator) CMOS (Complementary Metallic Oxide Semiconductor)]; demonstrate Active Pixel Sensor with advanced processing capabilities on a single chip.
- X-2000 Technology Development: Deliver engineering model and flight set of avionics.
- Sounding Rocket Flights: Achieve launch success rate of 80% for sounding rocket flights.
- Balloon Flights: Achieve launch success rate of 80% for balloon flights.

**Target 1S7: Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs.**

Performance indicators have been drawn from technology development objectives for three missions. Indicators have also been established for the Keck Interferometer project and for achievement of research progress in the R&A program.

- SIM Technology Development: Complete System Requirements Review (SRR), initiate Phase B, and demonstrate stabilization for nulling to one nanometer.
- TPF Technology Development: Award architectural definition contracts, develop Request For Proposals (RFP) for second phase of industrial contracts, and test starlight nulling breadboard.
- ST-3 Technology Development: Successfully complete Preliminary Design Review (PDR); successfully complete project and spacecraft Critical Design Review (CDR).
- Keck Interferometer Technology Development: Combine 2 Keck telescopes; install first outrigger telescope.
- Research and Analysis: Issue NASA Research Announcement (NRA) for Research Opportunities in Space Science (ROSS).

**Target 1S8: Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program.**

Performance indicators have been drawn from the technology development objectives for the Europa Orbiter. Indicators have also been established for achievement of research progress in the R&A program, including especially the Astrobiology program.

- Europa Orbiter Technology Development: Complete Preliminary Design Review (PDR).
- Astrobiology Research: High-priority studies identified in the Astrobiology Roadmap will be carried out, the National Astrobiology Institute will conduct institute-wide functions using internet/video conferencing capabilities (i.e., executive council meetings, science seminars, group collaborations, education/outreach), and Institute research publications will reflect its interdisciplinary nature.
- Research and Analysis: Issue NASA Research Announcement (NRA) for Research Opportunities in Space Science (ROSS).

**Target 1S9: Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs.**

Performance indicators have been identified for education and public outreach efforts.

Education and Public Outreach: Successful achievement of at least six of the following eight objectives will be made.

- Every mission initiated in FY 2001 will have a funded education and outreach program with a comprehensive education and outreach plan prepared by its PDR.
- By the end of FY01, 10 percent of all research grants will have a funded education and outreach program underway.
- Enterprise-funded education and outreach activities will be in planning or implementation in at least 34 states.
- At least five Enterprise-funded research, mission development or operations, or education projects will be underway in Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges, with at least one being underway in an institution of each type.
- The Enterprise will provide exhibits, materials, workshops, and personnel at a minimum of five national and three regional education and outreach conferences.
- At least five major Enterprise-sponsored exhibits or planetarium shows will be on display or on tour at major science museums or planetariums across the country.
- The first comprehensive Space Science Enterprise Education/Outreach Report will be prepared that describes participants, audiences, and products for Enterprise education and outreach programs.
- Initial results of a pilot assessment of the Enterprise's approach to education and outreach will be available for determining whether adjustments in program direction or organization are needed.

**Target 1S10: Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs.**

Performance indicators have been identified for the Mars '01 Orbiter, scheduled to launch in FY01, and for a Discovery mission scheduled to be in development. Other indicators have also been identified for an operating mission, as well as for achievement of research progress in related R&A and DA programs.

- Mars '01 Orbiter: Deliver for launch, within 10% of planned development budget and schedule; successful launch and check-out.
- CONTOUR Development: Successful CDR, to document that the design meets all program level requirements.
- Mars Global Surveyor Operations: Complete primary mapping mission.
- Research and Analysis: Issue NASA Research Announcement (NRA) for Research Opportunities in Space Science (ROSS).

**Target 1S11: Develop the knowledge to improve the reliability of space weather forecasting by obtaining scientific data from three of five missions and by making satisfactory progress in related areas in R&A and DA programs.**

Performance indicators have been identified for four operating missions. Indicators have also been established for another mission scheduled to launch in FY01 (to be utilized upon successful launch), as well as for achievement of research progress in the R&A and DA programs.

- ISTP Operations: Continue to collect 85% of data acquired from the ISTP spacecraft and successfully execute the Wind trajectory plan.
- ACE Operations: Measure the composition and energy spectra of heavy nuclei in six solar energetic particle events; measure the frequency and composition of coronal mass ejection events during the year; maintain real-time solar wind data 90% of the time.
- SAMPEX Operations: Obtain at least 60% data coverage from at least three of SAMPEX's four instruments.
- TRACE Operations: Conduct solar observing operations during all orbits where EUV images of the sun can be obtained using a 5-day-per-week/8-hour-per-day planning and operations cycle; deposit all TRACE data products into a web-based data system.
- HESSI Operations: Obtain hard-X-ray images of solar flares with angular resolution approximately 2 arcseconds and energy resolution approximately 1 keV (kilo-electron volts); obtain high-resolution X-ray and gamma-ray spectra of solar flares with approximately 1 keV energy resolution to energies as high as 20 MeV (million electron volts).
- Research and Analysis: Issue NASA Research Announcement (NRA) for Research Opportunities in Space Science (ROSS).

**Target 1S12: Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in core technology programs and by making progress as planned in the Flight Validation program.**

Performance indicators have been identified for core technology programs (information systems, intelligent systems, high performance computing, and Explorer program technology), as well as for the Flight Validation program.

- Information Systems: Demonstrate Virtual Observatory capability from investigator workstation for multi-wavelength discovery, analysis, and visualization across collective set of space and ground astronomical surveys; demonstrate a Virtual Mars capability simulating rovers navigating Mars terrain, for planning and design of future Mars missions.
- Intelligent Systems: Awards will be made at the beginning of the 2001 program year. A second research opportunity cycle will begin in late 2001, targeted toward a second set of awards in mid-2002.
- High Performance Computing: Demonstrate a real-time capability with software-implemented fault tolerance for embedded scalable computers. Real-time performance latencies of less than 20 milliseconds are to be sustained at fault rates characteristic of deep space and low-Earth orbit (LEO).
- Explorer Program Technology: Complete 45 Explorers Technology Investigations selected in FY99. Implement awards for additional investigations planned for selection in FY00.
- Flight Validation: Complete ST-5 CDR.

**New Initiative**

**Living With a Star: Further understanding of basic natural processes and the effects of solar variability on humans and technology.**

Performance indicators have been established for Living With a Star.

- Strategic Plan: Complete Living With a Star Strategic Plan, including mission architecture, for the OSS Strategic Plan.
- Solar Dynamics Observatory: Complete definition study for the Observatory, the first major new flight mission for Living With a Star.
- Research & Data Analysis: Initiate targeted data analysis and modeling research grants program.

## **Earth Science Enterprise Performance Targets and Indicators**

**Target 1Y1: Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives.**

- The Earth Science Enterprise (ESE) will successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Science research and applications goals and objectives.
- At least 90% of the total on-orbit instrument complement will be operational.

**Target 1Y2: Successfully disseminate Earth Science data to enable our science research and applications goals and objectives.**

- Make available data on prediction, land surface, and climate to users within 5 days.
- Increase by 20% the volume of data archived compared to FY00 (target = 442 terabytes).
- Increase the number of distinct Earth Observing System Data and Information System (EOSDIS) customers by 20% compared to FY00 (target = 1.5 million).
- Increase products delivered from the Distributed Active Archive Centers (DAACs) by 10% compared to FY00 (Target = 5.4 million).
- User satisfaction: Increase the number of favorable comments from DAAC and Earth Science Information Partner (ESIP) users as recorded in the customer contact logs over FY00. Implement user satisfaction survey.
- Decrease total percentage of order errors by 5% over FY00.

**Target 1Y3: Explore the dynamics of the global carbon cycle by developing, analyzing, and documenting multi-year data sets.**

- Develop a multiyear global time series of phytoplankton biomass and primary productivity for assessing interannual variability in marine ecosystems on regional scales and daily to interannual time scales. Collect near-daily global measurements of ocean chlorophyll and primary productivity using Moderate Resolution Imaging Spectroradiometer (MODIS) on the EOS Terra and Aqua satellites, merged with SeaWiFS data.
- Continue to refresh the global archive of 30 m land imagery seasonally with Landsat-7.
- Use of MODIS on Terra and Aqua to estimate the efficiency of the carbon uptake by phytoplankton (i.e., photosynthesis) for the first time. Also, demonstrate the value of such measurements in assessing carbon and nitrogen cycling in the open ocean by testing their utility in biogeochemical models.
- Estimate global carbon stocks and the role of land ecosystems, and evaluate human impacts on land cover changes. Develop the first global sample of vegetation height and vertical structure by using data from first Earth System Science Pathfinder (ESSP) mission, the Vegetation Canopy Lidar (VCL). Canopy height will be estimated to within 1 meter.

**Target 1Y4: Explain the dynamics of global carbon cycle by building improved models and prediction capabilities.**

- Through incorporation of data from field experiments and satellite data analysis funded by the Biology and Biogeochemistry of EcoSystems and the Global Carbon Cycle research and analysis programs; improve, by at least 15%, the ecological models

needed to predict ecosystem responses to global environmental changes. This work will be done by NASA-funded investigators at universities and government laboratories.

- Provide information to understand remotely sensed observations of productivity that will be useful for improved prediction and management of food and fiber production. This will be accomplished by extending the long-term 1-4 km satellite record of global terrestrial productivity and its seasonal and interannual dynamics that was begun with the Advanced Very High-Resolution Radiometer (AVHRR). Continued data set with the near-daily global measurements from instruments on the EOS Terra spacecraft, using primarily the MODIS instrument.

**Target 1Y5: Explore the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets.**

- Resolve the wide disparity of precipitation estimates that currently exist to within 20 percent, thus improving our understanding of the global water cycle. The Tropical Rainfall Measuring Mission (TRMM) will obtain accurate maps of the diurnal cycle of precipitation and, in conjunction with a 10+ year reanalysis of SSM/I data, set a benchmark allowing us to define the natural variability and climatology for tropical precipitation.
- Decrease the uncertainty in determinations of radiation forcing and feedback, and thereby increase accuracy in our knowledge of heating and cooling of the Earth's surface and its atmosphere. Continue the analysis of global measurements of the radiative properties of clouds and aerosol particles being made by the MODIS, the Multi-Angle Imaging Spectrometer (MISR), and the Clouds and Earth's Radiant Energy System (CERES) instruments on the EOS Terra satellite.

**Target 1Y6: Explain the dynamics of global water cycle by building improved models and prediction capabilities.**

- Improve current understanding and model the large-scale effects of clouds in climate. Complete collection and processing of satellite data needed for the multi-decadal global cloud climatology being developed under the International Satellite Cloud Climatology Project (ISCCP).
- Validate parameterizations of Earth's radiative processes in models that simulate the cycling of fresh water through Earth's atmosphere. Complete a decadal Surface Radiation Budget (SRB) climatology.
- Demonstrate over a variety of landscapes the capability to measure and diagnose soil moisture from airborne platforms, in preparation for a space-flight trial of soil moisture remote sensing. Soil moisture is an important land surface state variable, currently unmeasured at large spatial scales, that affects weather and climate.

**Target 1Y7: Explore the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets.**

- Complete detailed mapping of thinning/thickening rates for all major ice catchments on the Greenland Ice Sheet. This will serve as a baseline for future satellite-based surveys, to determine the behavior of the ice sheet and its influence on global sea level change. Use airborne laser altimeter data and analysis from the Climate Variability and Prediction Program.
- Use Jason-1 satellite data to continue the measurement of ocean basin-scale sea-level variability and reducing errors to less than 3cm.
- Provide a quantitative understanding of the solar forcing of Earth's climate. Continue acquisition of a total solar irradiance dataset for the complete period of maximum solar activity. Continue the high precision, multi-decadal record of total solar irradiance measurements towards capturing three solar cycles. Enabled by the launch of Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSAT) in FY00.

**Target 1Y8: Explain the dynamics of long term climate variability by building improved models and prediction capabilities.**

- Develop and the capability to measure and diagnose open ocean variations in salinity by 0.1 psu in preparation for a space-based system.
- Improve the understanding and modeling of the aerosol radiative forcing of climate and its anthropogenic component. Develop and validate aerosol retrieval and cloud screening algorithms, and processing of satellite data and transport model evaluations for the 20-year climatology of aerosol optical thickness and particle size.
- Demonstrate the experimental seasonal climate predictions based on observations from operating satellites. Use next-generation computing systems and new coupled air-ocean-land-ice models, incorporating all available satellite observations (e.g., TOPEX, Jason, Seawinds, TRMM, SeaWIFS, and MODIS) of key ocean surface parameters such as wind vectors and altimetry.
- Enhance the accuracy of long-term climate variability and change models.

**Target 1Y9: Explore the dynamics of atmospheric composition by developing, analyzing, and documenting multi-year data sets.**

- Provide continuity of multi-decadal total ozone concentration measurements to aid in characterization of long-term evolution of ozone and enable assessment of ozone recovery processes.
- Continue to monitor atmospheric concentrations of chlorofluorocarbons (CFCs) and new industrial substitutes to understand their impact on ozone concentration.
- Develop a comprehensive climatology of high-resolution ozone vertical distribution in the southern subtropics. This climatology will be used to verify the quality of experimental algorithms used to obtain tropospheric ozone from Total Ozone Mapping Spectrometer (TOMS) data.
- Characterize long-term evolution and interannual variability in high latitude ozone, aerosol, and polar stratospheric cloud profiles.
- Obtain the first measurement of sunrise-to-sunset variations in global ozone aerosol distributions. Also, obtain the first daily diurnally integrated estimates of surface UV radiation using satellite data for the entire sunlit Earth.



**Target 1Y10: Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities.**

- Provide increased prognostic ability for Northern Hemisphere high latitude ozone loss in an atmosphere perturbed by an increased abundance of greenhouse gases. This will be accomplished via a comprehensive analysis of data from the SOLVE campaign.
- Provide improved assessment of role of the global budget of carbon monoxide and methane (including its role in the global carbon cycle) through the development of the first global climatology of carbon monoxide and total column methane. This will be accomplished via use of Measurements of Pollution in the Troposphere (MOPITT) instrument aboard the EOS-Terra satellite.
- Characterize atmospheric plume flowing out of East Asia, its evolution as it transits eastward over the Pacific Ocean, and its contribution to global atmospheric chemical composition. Conduct the Transport and Chemical Evolution over the Pacific (TRACE-P) airborne campaign using DC-8 and P3-B together with satellite data and chemistry/transport models.

**Target 1Y11: Explore the dynamics of the Earth's interior and crust by developing, analyzing, and documenting multi-year data sets.**

- Enable near-real-time assessment of ground deformation for disaster response after earthquakes, continuous monitoring of large structures over time to detect subsidence or landslide vulnerability, and swelling of the ground as a precursor to explosive volcanic eruptions. Provide daily orbit solutions for Global Positioning System (GPS) constellation as a basis for cm-level satellite orbit determinations and mm-level ground based GPS positioning and navigation.
- Conduct global geologic and geomorphic process studies, comparative analysis, improved mapping of terrain features such as floodplains, and input to models for improvement of hazard assessment/mitigation. Conduct analysis of near-global Shuttle Radar Topography Mission (SRTM) 30-meter topographic data.

**Target 1Y12: Explain the dynamics of the Earth's interior and crust by building improved models and prediction capabilities.**

- Improve understanding of geodynamic processes and allow continuous observations, improved data processing efficiency and reduce operational costs by 20%. Complete the Very Long Baseline Interferometry (VLBI) Mark IV Correlator upgrade.
- Provide a basis for future tectonic modeling and earthquake vulnerability assessment. Complete installation of Southern California Integrated GPS Network (SCIGN) array of 250 precision GPS locators/receivers for monitoring strain accumulation in Southern California.

**Target 1Y13: Achieve success with timely development and infusion of technologies. Enable future science missions by increasing technology readiness for mission concepts to reduce their total cost.**

- Annually advance at least 25% of funded instrument technology developments one TRL.
- Develop advanced information systems technologies and concepts for processing, archival, access, and visualization of ESE data.
- Develop at least 3 technologies to demonstrate in space with the third Earth Observer New Millennium satellite.
- Transfer at least one technology development to a commercial entity for operational use.

**Target 1Y14: Provide regional decision-makers with scientific and applications products/tools.**

- Establish at least a second of seven Regional Earth Science Application Center (RESAC) as a self-sustaining entity.
- Improve availability of Landsat data to State and local governments by producing a digital image database of all 50 states once every two years (first of two-year cycle).
- Develop capability to assess the vulnerability of fishing grounds due to water quality issues using remote sensing and ground based information.
- Develop experimental models to demonstrate an ability to improve forecast skill levels for projecting the paths of severe storms using satellite derived sea surface winds, precipitation & surface temperature from QuikScat, TRMM, Seawinds 1A, Terra, Ocean Topography Experiment (TOPEX) and Jason-1.
- Develop a prototype capability to monitor and predict the track of at least one key atmospheric pollutant.
- Develop a predictive capability for outbreaks of malaria in Central Africa.
- Initiate two Applications Research projects with the public and private sector to develop and assess techniques to monitor and verify carbon storage in vegetation and soils.

- Develop at least two new data products for routine decision-making by user organizations involved in ESIP Cooperative Agreements and the Agriculture, Forestry and Rangeland Cooperative Agreements and Grants.

**Target 1Y15: Improve access to and understanding of remotely sensed data and processing technology.**

- Foster applications of remote sensing data and processing technology by involving at least 20 states in using Earth Science observations, information through informational workshops.
- Increase the operational application of remote sensing technology by initiating at least ten joint Application Research pilot projects (5-yr projects) with State and local governments addressing their specific needs as identified at planning workshops.
- Develop workforce skills needed in remote sensing, Geographic Information System (GIS), and other attending technologies by implementing at least ten active student internships at the State and local level.

**Target 1Y16: Stimulate the development of a robust commercial remote sensing industry.**

- Develop ten new market commercial products (e.g., oil spill containment software by EarthSat and map sheet products by Earth Resources Data Analysis System (ERDAS), Inc.), in joint commercial applications research projects.
- Identify at least one new commercial source of science data as a result of the Scientific Data Purchase activities for Earth Science research and applications.
- Develop four new validated commercial information products as a result of verification and validation partnerships with the private sector and other users through the Mississippi State Commerce Initiative and the Space Act Agreement.
- Conduct Earth Observation Commercial Applications Program (EOCAP) Technology projects that result in ten prototype products that quantify the utility of Hyperspectral and Synthetic Aperture Radar (SAR) technologies and define future market requirements.
- Increase the cost share leveraging with companies, academia and other government agencies within the EOCAP and Affiliated Research Centers (ARC) programs by 10%.

**Target 1Y17: Increase efficiencies in food and fiber production with the aid of remote sensing.**

- Conduct at least 30 joint applications research endeavors in conjunction with the U.S. Dept of Agriculture.

**Target 1Y18: Increase public understanding of Earth system science through formal and informal education.**

- Continue 90 existing grants and award 50 new graduate student research and education grants.
- Continue 17 early career grants in research/education and initiate at least two new collaborative projects in the Earth Science international young investigator program.
- Conduct at least 400 workshops training K-12 teachers of OES education products; a 13% increase over FY2000.
- Increase participating teachers in Global Learning and Observation to Benefit the Environment (GLOBE) to 13,800, and increase participating countries to 87.

## **Human Exploration and Development of Space Performance Targets and Indicators**

**Target 1H1: Complete testing and delivery for spacecraft integration of experiments for the Mars Surveyor Program 2001 orbiter and lander missions.**

- Complete testing and delivery for spacecraft integration for the radiation monitoring experiment hardware (MARIE)
- Complete testing and delivery for spacecraft integration for the soil and dust analysis experiment (MECA)
- Complete testing and delivery for spacecraft integration for the Mars In-Situ Propellant Production Precursor experiment (MIP)

**Target 1H2: Complete initial next decade planning mission architecture studies and technology plans.**

- Complete initial next decade planning mission architecture studies

**Target 1H32: Initiate the HEDS Technology/Commercialization program and establish a synergistic relationship with industry.**

- Indicator is a successful response to the initial NASA Research Announcement, with a 50% cost share from industry, where appropriate.

**Target 1H3: Support an expanded, productive research community to include 975 investigations annually by 2001.**

- Expand support to approximately 975 investigations (from 877 reported in FY 99).
- Publish abstracts and reports of progress for over 90% of FY 2000 research investigations (tasks) and make this publication available on the Internet.
- Support publication of approximately 1500 journal articles in refereed journals.
- Support emergent microgravity research programs in biophysics and tissue engineering by selecting up to 10 new investigations.

**Target 1H4: Conduct outstanding peer-reviewed and commercial research on STS 107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion.**

- Acquire unique data to improve crew health and safety and expand understanding in biology, biotechnology cell science, fluid physics, and combustion science.

**Target 1H5: Begin research on the International Space Station.**

- Increase fundamental knowledge in biological and biomedical sciences and address critical questions in crew health and safety by conducting 6 to 10 ISS investigations

- Acquire unique data on colloidal self-assembly as an essential first step in the synthesis of new materials from colloidal particles.
- Measure the ISS acceleration environment, develop models to characterize the effects of that environment on ISS research, and disseminate those results to the ISS investigator community.

**Target 1H6: Expedite a safety improvement program to ensure the continued safe operations of the Space Shuttle that ensures the availability of a safe and reliable Shuttle system to support Space Station Assembly milestones and operations.**

- CLCS application for the Orbiter Processing Facilities is completed.

**Target 1H7: Achieve 8 or fewer flight anomalies per mission.**

- Achieve 8 or fewer flight anomalies per mission

**Target 1H30: Achieve 100% on-orbit mission success**

- Pre-flight mission/payload objective
- Post-flight mission report

**Target: 1H10: Successfully complete the majority of the planned development schedules and milestones required to support the Multi-element Integration Testing**

- Complete Multi-Element Integration Test II (MEIT) to include flight elements for assembly flights 8A through 12A. This will be measured by completion of five planned test configurations. MEIT Tests perform integration testing with several launch elements to increase on-orbit confidence.

**Target: 1H11: Successfully complete the majority of the ISS planned on-orbit activities such as delivery of mass to orbit and enhanced functionality.**

- Continue to expand the capabilities of the ISS through launch and delivery of 180,000 lbs. of hardware and logistics to the ISS.
- Initiate and demonstrate station-based Extravehicular Activity (EVA) capability to support up to 30 EVAs annually from the U.S. Airlock. This will be measured by completion of a minimum of 5 EVAs from the ISS Airlock.

**Target: 1H12: Successfully complete the majority of combined ISS planned operations schedules and milestones as represented by permanent human on-orbit operations.**

- Conduct permanent human on-orbit operations with an estimated 8,000 crew hours dedicated to assembly, vehicle operations and payload operations.

**Target: 1H13: Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities.**

- Initiate on-orbit research in the U.S. Laboratory focusing on early payload opportunities in the Human Research Facility (HRF-1) and four multipurpose EXPRESS Racks.
- Complete integration testing and KSC processing for the Microgravity Sciences Glovebox (MSG), refrigerator/freezer, and Window Observational Research Facility (WORF-1) in preparation for launch on UF-1 and UF-2. This will be measured by completion of schedule milestones.

**Target: 1H14: Successfully complete no less than 85% of the planned Russian Program Assurance schedules and milestones required for the development of the Propulsion Module.**

- Initiate Propulsion Module Fabrication/Assembly/Integration and Testing in preparation for launch in late FY 2002. This will be measured by completion of schedule milestones.

**Target: 1H15: Successfully complete no less than 75% of the planned crew return capability schedules. FY01 indicators will include accomplishment of program schedule milestones for Phase 1 development of a crew return vehicle (CRV) that could provide the U.S. crew return capability.**

- Complete Crew Return Vehicle (CRV) Phase 1 tasks including Preliminary Design Review (PDR). This will be measured by completion of schedule milestones.

**Target: 1H17: Develop new biomedical and technological capabilities to facilitate living and working in space and return to Earth.**

- Flight test countermeasure to reduce kidney stone risk
- Develop two new evidence-based health protective countermeasure candidates ready for evaluation in an operational setting.

**Target: 1H18: Develop and demonstrate technologies for improved life support systems.**

- Demonstrate, in ground test, technologies that could reduce up to 25% of life support logistics over ISS baseline and release report of progress for review on the Internet.
- Perform detailed calculation of life support equivalent system mass index and place online for review and comment. Equivalent system mass index is a measure of the performance of a life support system incorporating demonstrated technologies.

**Target: 1H31: Initiate implementation of the Bioastronautics Initiative.**

- Initiate NASA/NCI collaboration to develop minimally invasive technologies and approaches for detecting and interpreting biological signatures that signal the emergence of disease.
- Initiate expansion of the teams and tasks of the NSBRI for the development of countermeasures by adding approximately 15 investigations (NSBRI tasks).

**Target: 1H20: Increase the percentage of the space operations budget allocated to acquisition of communications and data services from the commercial sector to 15%.**

- Increase to 15% the space operations budget allocated to acquisition of commercial communications and data services from the 10% FY 2000 performance target.

**Target: 1H21: Achieve at least 95 percent of planned data delivery from space flight missions as documented in space, ground, deep space, and NASA integrated service networks performance metrics consistent with detailed program and project operations requirements in project service level agreements.**

- Achieve at least 95 percent data delivery for all space flight missions as documented in network performance metrics.

**Target: 1H22: Establish at least ten new, active industrial partnerships to research tomorrow's space products and improve industrial processes through NASA's Commercial Centers, and find opportunities for space experiments**

- Ensure that Commercial Centers execute ten new partnership agreements
- Monitor the ratio of flight experiments to ground experiments

**Target: 1H23: Foster commercial endeavors by reviewing and/or implementing new policies and plans, such as the Space Station resource pricing policy and intellectual property rights policy. Ensure that Space Station resources allocated to commercial research are utilized by commercial partners to develop commercial products and improve industrial processes.**

- Review and/or implement Space Station resource pricing and intellectual property rights policies.
- Ensure Space Station resources allocated to commercial research are utilized by commercial partners to research tomorrow's products and improve industrial processes.

**Target: 1H26: Support participation in HEDS research.**

- Enable at least 50 students to participate in commercial space flight and technologies research.
- Through the use of national teacher conferences and workshops, provide approximately 200 elementary and high school classrooms nationwide with electronic (multimedia/computer technologies) and printed materials that focus on activities in science, math and technology relating to life sciences and microgravity research and specifically written for students in grades K-12
- Complete a broadly based student competition on innovative design concepts that address HEDS technological challenges.
- Complete customer engagement plan

### **Cross-cutting target**

**Target: 1H29: Improve health of the NASA workforce**

- Developing and implement supervisor-specific training for the identification and management of stress in the work unit. Develop and implement training on techniques for coping with stress for the individual employee.
- Begin a robust audit program of NASA Centers' occupational health programs, completing at least six (6) to ensure quality and continuous improvement of medical care and services including medical and environmental monitoring efforts, preventive services, emergency response capability, and clinical intervention capability.



## **Aero-Space Technology Enterprise Performance Targets and Indicators**

**Target 1R1: Complete 75% of the conceptual designs of systems for preventing and mitigating accidents (programmatic performance indicators are listed below), and to demonstrate tools for accident analysis and risk assessment.**

### Aero-Space Focused — Aviation Safety

- Conceptual designs of safety-improvement systems is completed for all projects
- Operational test of risk assessment aid: Demonstrate, in operational environment, tools for merging heterogeneous databases to aid causal analysis and risk assessment.
- Proficiency Standards: Identify flight crew knowledge and proficiency standards for automation.
- Integrated onboard health management system design: Define architecture for integrated onboard health management system.
- Concepts to limit fires: Develop proof-of-concept of technology to limit fuel flammability.
- Design criteria for low false alarm: Establish design criteria for reliable, low false-alarm fire detection systems.
- Synthetic vision retrofit concepts: Selection synthetic vision concepts suitable for retrofit in commercial, business, and GA aircraft.

### Aero-Space Base R&T

- Demonstrate Intelligent Life Extending Control (ILEC) for a commercial aircraft engine through hardware in the loop simulation using component damage modeling.
- Combine Propulsion Controlled Aircraft (PCA) control laws with the Intelligent Flight Control System (IFCS) to demonstrate a new capability for adapting to absence or loss of any and all control surfaces resulting from failures or malfunctions up to and including propulsion only flight.
- Provide alloys for engine blades and disks which are more crack resistant.
- Flight validate advanced control laws and modes for reduced pilot workload and increased safety in low visibility using integrated design tool Control Designer's Unified Interfaces (CONDUIT).
- Complete report on Phase I testing of tire dynamics mechanical properties.
- Identify and evaluate existing crew strategies for reducing errors in the management concurrent tasks
- Downselect of ground-based remote sensor technologies for a prototype ground-based system to sense icing conditions.
- Issue an ultra-safe gear design guide for rotorcraft
- Demonstration of strong correlation of analytic model predictions of rotorcraft crashworthiness with full-scale water/soft-soil-impact test results
- Health and Usage Monitoring Systems (HUMS) Certification Protocols detailed for rotorcraft
- Submit documentation of certification methodology for rotorcraft composite structures analysis / certification
- Demonstration of “express-tool” technology linkage to design technologies that reduce design-to-fabrication time by 50 percent for sophisticated rotorcraft parts and assemblies

**Target 1R2: Complete one system level technology benefit assessment, one component concept selection and one new material system.**

### Aero-Space Focused — Ultra-Efficient Engine Technology

- Select turbine flow control concept(s)
- Develop 1350°F turbomachinery disk alloy
- Define propulsion system concept(s)
- Complete selection of the most promising simulation approach for predicting propulsion-airframe integration effects for unconventional aircraft

### Aero-Space Base R&T

- Complete development of heavyweight (laboratory) energy storage (fuel) cell, electrolyze, control system.
- Investigate active control of high-frequency instabilities in combustion flows
- Demonstration of "smart" panel technology with a wind tunnel test of a smart UCAV with hingeless control surfaces.

**Target 1R3: Complete large scale demonstration of a 2-5 decibel reduction in aircraft noise based on 1997 production technology, and initial assessments of concepts offering additional reduction**

Aero-Space Focused — Quiet Aircraft Technology

- Airframe and engine noise reduction concepts that individually or collectively show analytical potential for at least 3 decibel further reduction in noise levels.

Aero-Space Base R&T

- Full-scale static engine validation of fan and jet noise reduction concepts including active control of fan tones, and large-scale wind tunnel validation of airframe noise reduction concepts

**Target 1R4: Complete the civil tiltrotor project by validating databases for contingency power, flight paths, and noise reduction, as well as complete at least one demonstration of an airspace management decision support tool.**

Aero-Space Focused — Aviation Systems Capacity

- Comprehensive mission simulation database integrated cockpit and operating procedures for complex, low noise flight paths.
- Large scale database of noise reduction and validated design for noise capability.
- Develop and demonstrate transition airspace decision support tools for: (1) ATC/airline operations center and ATC/cockpit information exchange, and (2) conflict resolution.

Aero-Space Base R&T

- Demonstrate a prototype data communications scheme for the National Airspace System.

**Target 1R7: Complete the Advanced General Aviation Transport Experiments project by validating transportation system concepts through flight test and publish design guidelines; establish at least one partnership agreement on Small Aircraft Transportation System program.**

Aero-Space Focused — Small Aircraft Transportation System (SATS)

- Partnership agreement signed by NASA and at least one state government and one industry member
- Joint Sponsored Research Agreement signed with Virginia Space Grant Consortium partners to develop a SATSLab comprised of aircraft, airports, and airspace for validation of SATS vehicle and infrastructure features and capabilities.

Aero-Space Base R&T

- Complete the development rig test of the hot section foil bearing for a representative general aviation engine.
- Simulate and flight test validated AGATE system concepts
- Publish design guidelines; system standards; certification bases and methods
- Completed systems analysis of the benefits of STOL & ESTOL vehicles to the small aircraft transportation system.

**Target 1R8: Develop at least three new design tools and accomplish at least four demonstrations of advances in computation and communications.**

Aero-Space Focused — High Performance Computing and Communications

- Develop software tools to reduce parallelization time from months to one week while maintaining 50% application performance compared with manual parallelization.
- Develop tools to benchmark testbed performance in computing capability, database manipulation, and scheduling to evaluate alternate scheduling strategies and chose optimal approaches to reduce variability and improve predictability of turnaround time
- Develop automated quality of service data collection tool capable of measuring 2 service classes and scalable to at least 5 nodes
- 3 relevant application codes parallelized; 3 data analysis codes parallelized; documented evaluation of parallelization tools.
- 3X performance in an aerospace application through the integration of networking enhancements into application codes.
- 3 applications interoperating on multiple QoS enabled networks; 50Mbps (aggregate internal) multicast; gigabit performance between 2 NASA sites; 2 applications utilizing enhanced hybrid networking.
- Improvement in aerospace applications: Complete combustor and compressor simulation in 3 hours each; high-fidelity space transportation vehicle analysis in 1 week and optimization enabled; S&C database generation for aerospace vehicles within 1 week; demonstration of improvements in 4 NASA-sponsored design events.
- Assess initial HPCC technology capabilities and customer impacts.

#### Aero-Space Base R&T

- Develop software tools for design of advanced computing systems
- Acquire and incorporate new large-scale computing systems and demonstrate seamless operations with heterogeneous distributed computing environment.
- Demonstrate remote connectivity to high data-rate instruments and distributed real-time access to instrument data.
- Demonstrate an environment for aerospace hardware design that includes: remote connectivity and access to flight simulation data, computational simulation data and archival databases.
- Demonstrate prototype cross-fidelity aerospace design system.
- Establish experimental and analytical methodology for composite stringer pull-off failure prediction.
- Figures of merit from static wind tunnel or CFD results developed and assessed for use in predictions of uncommanded transonic lateral motions due to Abrupt Wing Stall
- Conduct turbulence modeling workshop to provide direction for turbulence modeling research to increase design confidence in flight regimes dominated by flow separation
- Conduct assessment of OAT program element impacts on goals of three pillars

#### **Target 1R9: Demonstrate two new concepts in flight and identify three new concepts for further examination.**

#### Aero-Space Base R&T

- Demonstrate solar-powered remotely-piloted aircraft suitable for science missions to an altitude of 100,000 feet.
- Complete development of a pulse detonated engine inlet
- Complete final validation and testing of an integrated blended-wing-body (BWB) low-speed flight research vehicle in preparation for flight in 2002.
- Complete inlet test for Pulse Detonation Engine application
- Complete second flight of Hyper-X (X-43) at Mach 7
- Complete flight testing of Hyper-X (X-43) at Mach 10.
- Complete an integrated blended-wing-body (BWB) low-speed flight research vehicle prepared and delivered for final validation and testing.
- Identify advanced vehicle concepts for further research
- Demonstrate robust taxi capability with contingency planning for an autonomous vehicle
- Complete 60% of planned experiments on the F-15B testbed aircraft

**Target 1R10: Complete assembly of the third X-34 test vehicle, demonstrate 75% of supporting technology developments (programmatic performance indicators are listed below), and complete competitive solicitations for expanded 2<sup>nd</sup> generation reusable launch vehicle efforts.**

Aero-Space Focused — X-33

- A performance indicator for the X-33 is not possible until the liquid hydrogen tank delamination investigation and program impact assessment are complete.

Aero-Space Focused — X-34

- Complete the third X-34 (A-3) vehicle assembly.

Aero-Space Focused — Future-X

- The integrated vehicle health monitoring system flight experiment is delivered for installation in the X-34

Aero-Space Focused — 2<sup>nd</sup> Generation RLV Focused

- Award multiple industry contracts for Systems Engineering and Requirements Definition, RLV Competition and Risk Reduction and NASA Unique Systems program elements

Aero-Space Base R&T

- Complete assessment and preliminary design of Pulse Detonation Engine-based hybrid cycle and combined-cycle propulsion systems.
- Complete Phase 1 modifications of the Numerical Propulsion Simulation System to allow analysis of a rocket and a rocket-based-combined-cycle propulsion systems
- Identify protocols and test methods needed for accelerated testing of space transportation vehicle materials
- Extrude near-net thin walled sections of Russian alloy 1441 for aerospace applications
- Complete RLV focused composite cryogenic tank and structures technologies
- Combined Cycle Engine System Selected for first Flight Demonstrator
- Combined Cycle Flowpath Definition and Testing Completed for First Flight Demonstrator

**Target 1R11: Commence X-37 vehicle assembly, and complete one Pathfinder flight experiment.**

Aero-Space Focused — Future-X

- Commence X-37 vehicle assembly
- ProSEDS evaluation completed
- Flight of Hall Effect Thruster experiment

**Target 1R12: Continue the solicitation of customer feedback on the services, facilities and expertise provided by the Aero-Space Technology Enterprise**

Triennial Customer Survey

- Complete the Triennial Customer Satisfaction survey, and maintain a "highly satisfied" rating from 35 percent of Enterprise customers.

Facility Utilization Survey

- Achieve a facility utilization customer satisfaction rating of 95 percent at "5" or better, and 80 percent "8" or better ,based on exit interviews.

Technology Transfer

- Transfer at least twelve new technologies and processes to industry during the fiscal year.

**Target 1R13: Continue the implementation of current education outreach plans, and establish new plans for all new program activities initiated in FY 01.**

Education Outreach

- Implementation examples from current education outreach plans.
- Documented plans for all new program activities initiated in FY 2001.

## **Manage Strategically Performance Targets and Indicators**

**Target 1MS1: NASA will increase the safety of its infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees.**

- Per President Clinton's direction under the Federal Worker 2000 Presidential Initiative, reduce the overall occurrence of injuries (due to occupational injury or illness) by 3% per year from the FY 97 baseline to 1.15 occurrences per 100 workers
- Award of construction contract(s) for **all** identified critical facilities safety requirements as specified in the Agency Annual Construction Program.
- Award/modification of all planned contracts for physical security upgrades to NASA's Minimum Essential Infrastructure defined in the NASA Critical Infrastructure Plan.
- Reduced incidences of environmental mishaps or non-compliance from the FY2000 baseline year by 5%.
- Exceeding the FY 99 baseline for NASA's aggregate safety Performance Evaluation Profile (PEP).

**Target 1MS2: Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBC's), and maintain significant contractor involvement in NASA programs of small businesses, minority institutions, and minority and women owned businesses.**

- Maintaining PBC obligations at 80% of funds available for PBC's (funds available exclude grants, cooperative agreements, actions under \$100,000, SBIR, STTR, FFRDC's, intragovernmental agreements, and contracts with foreign governments or international organizations)
- Achieving at least an 8% goal for annual funding to small disadvantaged businesses (includes funding for prime and subcontracts awarded to programs supporting small disadvantaged businesses, historically Black Colleges and Universities, and other minority institutions, and women-owned small businesses)

**Target 1MS3: Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and personnel training.**

- Cost at least 75% of the resources authority available to cost during the fiscal year.
- Completing installation of the Budget and Core Accounting Integrated financial Management System at NASA's remaining field locations.
- Maintain a diverse NASA workforce wherever women, minorities, and persons with disabilities are represented at levels equal to or greater than their FY99 levels, with a target of increasing representation of minorities by at least one percent per year, women by at least one percent per year, and persons with disabilities by at least .5 percent per year.
- Increasing training opportunities in technology-based learning by 10%
- Increasing by 20% employee use of technology-based learning opportunities.
- Using FY 01 budgeted funds for awarding construction contracts toward reducing the Agency's estimated \$1.4B facilities revitalization needs.

- Implement 60% of the identified Environmental Compliance and Restoration projects to reduce and manage the Agency's \$1.1B future unfunded environmental liability .

**Target 1MS4: Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory," and enhance IT security through reduction of system vulnerabilities across all NASA centers, emphasizing IT security awareness training for all NASA personnel.**

- Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory" and holding costs per resource unit to the FY 98 baseline. (Note: Measurements are of processing capability in millions of instructions per second, bits of information processed per second, the per second cost of the preceding capacity, and customer feedback ratings on service requests as well as annual surveys of principal users.)
- (b) Enhance IT security through reduction of system vulnerabilities across all NASA Centers and through emphasis on IT security awareness training for all NASA personnel.

## **Provide Aerospace Products and Capabilities Performance Targets and Indicators**

**Target 1P1: Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.**

- Meet schedule and cost commitments by keeping development and upgrade of major scientific facilities and capital assets within 110% of cost and schedule estimates, on average.

**Target 1P2: Establish prototype collaborative engineering environments focused on the representative set of enterprise applications and evaluate performance against non-collaborative benchmarks.**

- Readiness test of prototype will be completed.
- Performance of prototype will be measured against benchmarks.

**Target 1P3: Ensure the availability of NASA's spacecraft and facilities by decreasing operating time lost to unscheduled downtime.**

- Ensure the availability of NASA's spacecraft and facilities by decreasing operating time lost to unscheduled downtime, relative to FY00 availability.

**Target 1P4: Capture a set of best practices/lessons learned from each Program, to include at least one from each of the four PAPAC subprocesses documented in NPG 7120.5, commensurate with current program status. Data will be implemented in PAPAC process improvement and in Program/Project Management training.**

- A set of best practices/lessons learned will be captured from each Program, to include at least one from each of the four PAPAC subprocesses, commensurate with current program status. Data will be implemented in PAPAC process improvement and in Program/Project Management training.

**Target 1P5: Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.**

- Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.



**Target 1P6: Dedicate the percent of the technology budget that was reported in the FY00 Performance Report toward leveraging with activities of other organizations.**

- Dedicate the percent of the technology budget that was reported in FY00 toward leveraging with activities of other organizations.

## **Generate Knowledge Performance Targets and Indicators**

**Target 1G1: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will obtain scientific guidance from their investigator communities.**

- At least seven letters of advice will be received from the enterprises' FACA-chartered advisory committees.

**Target 1G2: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will develop and/or release updated enterprise strategic plans.**

- The Space Science Enterprise and the Earth Science Enterprise will release new enterprise strategic plans, and OLMSA/HEDS will review its new strategic plan with their advisory bodies.

**Target 1G3: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will use competitive merit review wherever possible to select performers for science and basic technology research.**

- Taken together, the Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will use AOs, NRAs, and Cooperative Agreement Notice solicitations to award 80 percent or more of science and basic research funds via merit competition.

**Target 1G4: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will disseminate results of their research to a diverse population of users, including education users and the general public.**

- Research programs of the Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS, taken together, will account for 5 percent of the 150 “most important stories” in the annual review by *Science News*. The three enterprises will achieve their individual indicators in education and public outreach and publication of research progress. The three enterprises will maintain and periodically update publicly accessible web sites for active missions.

**Target 1G5: The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will make science data obtained widely accessible as soon as possible after receipt and will maintain these data in open archives.**

- The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will achieve their specific individual indicators for ensuring mission data maintenance and access.

**Target 1G6: Work with other federal agencies and U.S. industry to complement and support our activities.**

- Establish and implement MOUs and MOAs with U.S. Federal agencies and industry for appropriate partnerships in research areas of shared interest.

**Target 1G7: Pursue mutually beneficial cooperative activities in aeronautics and space with other nations.**

- Establish and implement LOAs and MOUs for appropriate partnerships with foreign space agencies for cooperative activities.

## **Communicate Knowledge Performance Targets and Indicators**

### **Target 1CK1: Convey information about, and knowledge generated by NASA's programs, to the public**

- Support no less than 800 portable exhibit loans and send portable exhibits to a minimum of 175 targeted events per year. Some of the NASA Centers have Internet sites that provide information about their exhibit loan programs. By the end of FY 01 all of the Centers will have this on-line resource.
- Track public attendance and participation in NASA's Fine Arts Program increasing viewership by 10 percent per year of NASA art and by reaching 40 states by the end of FY 2001.
- Increase the baseline for live satellite interview programs to no less than 15 live shots per month (on average), by facilitating astronauts, program managers and other Agency officials for live satellite interviews via NASA Television.
- Increase the NASA-sponsored, funded, and/or generated report documents for the scientific community and public to 14,059.
- Increase the nontraditional NASA-sponsored scientific and technical information through the NASA Image Exchange (NIX) digital image database to more than 550,000 in FY01.
- Produce 10 new historical publications chronicling and placing NASA's activities and achievements in perspective for the American public.

### **Target 1CK2: Assist the public and customers to locate and retrieve information on, or that has been generated by, a NASA program**

- Provide the public with quick service by assisting 98% of customers who use the Scientific Technical Information and the NASA Image Exchange Help Desks within a specific turnaround period of 3 days. (1CK2a)
- Make the NASA web pages as accessible to the public as possible. The goal is to increase the number of searched pages by 5 percent per year. (1CK2b)
- Increase the capacity of NASA's Home Page to meet public demand. The goal is to continue to provide for a 5 percent per year increase in download demand. 834,700 web pages were downloaded weekly in 1999.

### **Target 1CK3: Facilitate the transfer of NASA generated technology and innovations to private industry**

- Increase new opportunities to transfer technology developed at NASA to private industry to 20,100. Opportunities will be made available to the public through the NASA TechTracs database and will be accessible through the internet.
- Produce two industry-specific editions of *Aerospace Technology Innovations* publication in FY 2001.
- Provide publications that will communicate NASA technologies available for commercial use or that have already been commercialized. Print subscriber/distribution metrics are; *Aerospace Technology Innovations*, - 12,500, *Spinoff* - 51,000, and *Tech Briefs* - 210,000.

**Target 1CK4: Support educational excellence and reach out to the underserved and underrepresented minority community**

- With the increased level of funding provided in the FY 2001 President's Budget, NASA will be able to maintain education program level with participant involvement of approximately 3 million teachers, faculty, and students in the education community.
- Ensure that the NASA education program is meeting customer's needs by maintain an "excellence" rating of at least 4.3 on a 5.0 scale, as rated by those customers.
- After a 2 year flat budget, the increased funding provided in the FY 2001 President's Budget will enable NASA to increase the number of sites that offer pre-college Science, Engineering, Mathematics, and Aeronautics Academy curriculum by 2 from FY 1999.
- Produce 3 refereed papers or book chapters for each \$100,000 of research funding provided through the Minority University Research & Education Program.